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War Will Not Postpone Exposition

IN fairness to those who have succeeded in bringing the Panama-Pacific International Exposition to a point where its opening next February is assured the widest publicity should be given to a telegram in which Charles C. Morse, president of the exposition, asked Mayor Mitchel of New York to co-operate with him in silencing rumors to the effect that the exposition is to be postponed on account of the war. These rumors, Mr. Morse states, are utterly without foundation. When war was declared the Engineering Record's San Francisco representative interviewed the exposition officials and secured from them the definite statement that the hostilities abroad would not change the exposition plans. This paragraph, therefore, is written for those who did not read this announcement in the Current News Section of this journal Aug. 29.

Selection of Standards

SPACE did not permit comment last week on the very remarkable article by C. B. McCullough, of the Iowa Highway Commission, on the standards adopted by that organization for concrete highway bridges. The work he describes, however, is worth bringing to the attention of engineers because it shows the painstaking way in which the commission arrived at the standards which will govern throughout Iowa. Special attention should be called to the care with which various geological conditions were taken into consideration. While it will be contended that the factors discussed by Mr. McCullough are only those that should be evaluated in any proper analysis of an engineering situation of this magnitude it is a fact that such care is frequently lacking. That the structures designed after the more hurried and less adequate investigation are apt to suffer by comparison with those resulting from a thorough analysis goes without saying.

A Temporary Sewerage System

IN the design of the sewerage system for the 600-acre tract to be occupied by the Panama-Pacific International Exposition at San Francisco, described by William Clyde Willard on page 538, certain considerations made it necessary to depart from the standards of practice generally followed in municipal work. In the first place practically all of the sewers will be removed when the exposition closes, for much of the land was leased on the understanding that the exposition company should restore the ground to its original condition. Obviously, with such a stipulation, it would have been folly to adopt anything but the least expensive form of construction which would answer the purpose for a comparatively short time. The materials selected, therefore, were second-quality vitrified pipe and wood-stave pipe, the latter being used for diameters as large as 51 in. The total length of wood-stave pipe sewers is approximately 21,720 lin. ft., which is claimed as a record for this type of construction in a single system. Another local feature which had to be considered was the flatness of the topography and the limited fall available, for the ground surface is generally only from 3 to 6 ft. above the level of high tide in the bay. Portions of the site, in fact, are tidal basins and marshes filled by hydraulically sluiced material, so that the possibilities of settlement in these areas had to be taken into account. With the flat grades necessary a certain amount of sewage must be pumped, and in view of the closeness of the ground-water level to the surface the sewer joints, even though the construction is cheap and temporary, must be watertight. Otherwise the pumping costs would be greatly increased by the necessity of raising large quantities of ground-water which would seep into the line through defective joints. The interesting features of the exposition sewerage system, therefore, are the methods employed to meet certain local conditions which are very seldom encountered in designing permanent sewerage systems for cities.

Fireproofing of Shingles

COMMENT was made some time ago on the fire danger from the use of wooden shingles, and it was suggested that building ordinances prevent the use of wooden shingles or require that they be fireproofed. It may not be generally known that a considerable amount of research in the fireproofing of shingles has been under way for some time, both in the U. S. Forest Products Laboratory at Madison, Wis., and independently by an expert retained by the educational bureau of the Paint Manufacturers' Association of the United States. While final conclusions have not yet been reached, Henry A. Gardner, who is conducting the latter work, emphasized in a paper read before a convention of painters this summer that the mere use of a good quality of linseed oil paint carrying suitable pigments cut down the fire hazard very considerably. Not only has the dried paint shown itself resistant to fire, but its indirect effects are in themselves very important. First, the protection of a shingle from weather hinders it from warping and thus prevents the formation of pockets in which hot cinders may lodge. Furthermore, the irregularities of the surface which might retard burning particles are filled up by the paint. As to the actual retarding effect the results are very gratifying. It is very difficult to estimate quantitatively the degree of protection afforded, but untreated shingles, badly attacked by a 1 min. exposure to flame, are barely marred when painted. Under the 3-min. tests the unpainted shingle is severely burned, and while the painted specimen has been attacked the actual burning is limited to the area on which the flame was directed, the paint preventing the spread of fire and retarding the charring of the wood. Tests are under way, also, of various chemical retardants, a paint made with silicate of soda having given, thus far, very encouraging results. Research along these lines, needless to say, is well worth while, for there are good arguments in favor of the use of wooden shingles. Their protection, therefore, is a matter of no small economic importance.

The Engineer's Part in War

IN the daily reports from the European theaters of war one reads of a titanic struggle on land and sea, in the air and under water. Naturally interest centers particularly upon the operations of the combatant forces, but anyone versed in military affairs knows that the man who does the actual fighting is only one gear in the train which keeps the modern war machine running. Among the other essential parts in this complex mechanism are the commissary department, the hospital corps, the sanitary troops, and the engineer corps. The conflict in Europe has proved one thing clearly, and that is that the engineer has become one of the most vital factors in modern warfare. But in spite of his importance the engineer's work is rarely mentioned in the news from the front. The papers will tell of how the enemy was driven from his trenches at the point of the bayonet, but forget to mention how the engineer troops, working in a rain of shot and shell, built a bridge across the river in order to open up the way for the attack. It should be particularly interesting at this time, therefore, to learn from an authoritative source something about the organization, duties and equipment of the engineer troops of the German Army under campaign conditions, and the article on page 526, by Lieut.-Col. Joseph E. Kuhn, of the U. S. Army, will doubtless be widely read by technical men. The fundamentals of military engineering, Colonel Kuhn points out, do not differ from those governing civil practice, but the conditions are different. In war the element of time is all important, and the results are as often destructive as constructive. The military engineer has scant resources in the materials available for his use and he must display a degree of resourcefulness on quick notice which is not demanded from his brother in civil life.

A Position Restated

ATTENTION is directed to three letters, beginning on page 546, commenting on editorials in this journal Oct. 17, entitled, "A Question of Society Ethics," and "Societies and Specifications." It would be easy to be led astray into a lengthy and detailed discussion of various points in these letters. That would only result, however, in shifting the issue from what the Engineering Record intended—an issue plainly shown by the title of the first of these editorials, "A Question of Society Ethics."

Briefly put, the Engineering Record contended that the American Society of Municipal Improvements, by placing at the head of an important committee an engineer closely identified with manufacturers of a certain type of asphalt, rendered itself liable to criticism. It was explicitly stated that the Engineering Record did not "attribute any unworthy motives to anyone." To have done so would have been to claim that no man can honorably hold an opinion which is strongly favorable to a particular commercial interest.

The Engineering Record will not be drawn into a controversy over the so-called "open" and "alternative" specifications for asphalt. Its editorials, to which objections are made, dealt with a question of society ethics, not with the merits or demerits of reports, specifications, asphalts or individuals. It will perhaps answer all the questions and objections of the correspondents if the Engineering Record asks them to suppose that a committee of the American Society of Municipal Improvements, headed by a representative of the lake asphalt interests, had brought in a report recommending the "alternative" form of asphalt specifications. In such a case the criticism of the Engineering Record would have been just as applicable—and just as prompt.

New Field in Physical Science

AT the one hundred and fiftieth anniversary of the founding of Brown University a series of four lectures to be delivered by Prof. W. H. Bragg promises an account of what is really the most brilliant and sensational development in the physics of solids in the past half century. All the readers of this journal who are interested in the scientific side of our knowledge of the structure of things will do well to follow the reports of these lectures. It was Professor Bragg who, at the meeting of the British Association at Birmingham a year ago, opened for the first time what promises to be a field of wonderful fertility. In the first place he proved the identity of the X-rays with ordinary light, ending the long controversy that has been waged regarding their true nature. Second, and what is from the technical standpoint even more important, he proceeded to use these light rays for the investigation of the actual atomic structure of crystalline bodies. The masses and distances involved in this problem are so extremely small as to escape investigation by any other method, but the possession of light waves only 0.0001 of the length of those of visible light furnished a means of investigation on a scale even small enough to deal with atoms and their relations. The results thus far made public have shown that by this new method Professor Bragg has been enabled to study the minutest structure of solids in the form of crystals with a delicacy that promises an enormous increase in our knowledge of the forces which go to make up the constitution of solid matter. The outlook thus gained is certain to penetrate beyond physical theory into the exact technology of materials.

Closing the Doors of Public Service to Incompetents

THE recent activity of engineers in Pennsylvania in discussing the proposed draft of a bill requiring the general licensing of engineers in that State seems to refute the oft-repeated statement that technical men take no interest in matters which concern their relations to the public. The Philadelphia association of members of the American Society of Civil Engineers has opposed not only the tentative bill, but also any general licensing measure, and has suggested as a remedy for existing conditions the creation of a State department of engineering with power to approve or reject plans for engineering works, as already announced in this journal. The association has not stopped at this point, however, for its committee which reported on the licensing bill has recently issued a supplementary report (see page 544) proposing a plan to regulate the employment of engineers in public service.

Outside of such cities as Philadelphia, Pittsburgh and Scranton, engineers are usually appointed by a majority vote of county commissioners or local council and their fitness for performing the duties of their offices is not always as carefully investigated as desirable. To remedy these conditions the committee suggests that civil service examinations, with exemptions for technical positions above a certain grade, be required for engineers in all of the cities and towns of the State. The object of the plan is to prevent the engagement, through ignorance or political motives, of incompetent or unscrupulous engineers.

The success of such a measure, of course, would depend entirely upon the method of conducting the examinations. If every town or borough were given free rein in the examination of candidates for its engineering positions it is doubtful whether conditions would be greatly improved, for every local politician would have a finger in the pie. But by placing the entire responsibility in the hands of a central authority—a State civil service examination department—as the committee suggests, it is reasonable to expect that the towns of the State will receive a better grade of engineering service than in the past.

It is further suggested that the State civil service examination department should act in an advisory capacity in connection with the employment of consulting engineers or experts for special temporary engagements and that no engagements of that character should be legal without its approval. It is clear that this proposal would make the State department a very powerful factor in the conduct of engineering work throughout Pennsylvania, and if allowed to fall into the hands of politicians the whole structure would collapse. It is essential, therefore, that the members of the proposed State civil service examination department be technical men of the very highest standing, for upon their shoulders a grave responsibility will rest. In the very nature of things they will be subjected to political pressure and their moral fibre must be absolutely sound.

Dusting of Concrete Floors

WHY is it that in two concrete buildings apparently constructed under identical conditions, built by contractors of equal intelligence and integrity, from concrete composed of similar aggregates and the same brand of Portland cement, the floors in one will turn out hard, firm and resistant to abrasion, while in the other ordinary usage will result in dusting sufficient to make necessary some remedial measures?

The fact that numerous dustless concrete floors have been laid seems to indicate that the trouble must lie in the selection, proportioning, mixing, placing or finishing of the material. The procedure and proportions described below have given excellent results, though undoubtedly different mixes have also been used with satisfaction.

Special precautions should be taken to insure first-class work. A rich mixture is desirable, say, a 1:1:1 mix, in which the aggregate consists of granite, or other hard stone, screenings graded from ¼ in. in size down to the finest, and crushed stone of equal quality passing a ½-in. ring and retained on a screen having ¼-in. mesh. All troweling and finishing of the floor surface should be completed within 2½ hr. from the time the materials leave the mixer. This necessitates mixing the material for the wearing course to such consistency that the mortar has to be scraped from the wheelbarrows and will hardly flatten out when dumped upon the floor, yet wet enough so that it can be "struck off" with little difficulty when spread out with shovels. The floor usually is in a condition to be troweled for the last time within an hour and a half or two hours after the wearing course has been mixed. When sufficiently hardened to prevent pitting the floor should be sprinkled with water until 2 in. of sawdust can be thrown on the surface without injury. The sawdust should be thoroughly wet down and kept moist by sprinkling for a period of two weeks.

Numerous experiments in curing concrete have demonstrated conclusively the superior quality of specimens which are properly cured by being kept moist for a period of two weeks or more. Wetting is quite common with other types of concrete work and can be relied upon to give as satisfactory results with floors.

There are so-called hardeners on the market intended to be used with the finishing coat. In using these preparations careful supervision of the work from the time the concrete is mixed to the time that traffic is allowed on the floor is made a prime requisite for success. In all probability if the same care and attention are given to the workmanship and curing of floors in which no integral preparation is used, an excellent surface will result.

The Presiding Officer and the Success of Engineering Conventions

PRESIDING officers at engineering conventions or other gatherings of technical men can do a great deal to increase the value of the meetings. Not all men are gifted with a vigorous personality which creates enthusiasm, but it is possible for everyone called upon to hold the gavel to improve upon the lax methods sometimes observed.

In the first place, the presiding officer should familiarize himself with parliamentary procedure. Every library contains books on rules of order, and they are easily learned. There is no excuse for the chairmen who must confer continuously with the secretary. When such conferences become so frequent that it is the secretary rather than the presiding officer who runs the meeting it is not to be expected that those present will respond to such vicarious leadership.

Clearness of enunciation and definiteness of statement are important on the part of the presiding officer and other speakers. Interest lags when the audience cannot hear what is said. This fault can readily be corrected if the chairman sees to it that he is not an offender and that the speakers bear the matter in mind.

In gatherings where the members are not acquainted with one another it is always desirable to know the name of the speaker and the city he comes from, for his opinions are molded by local conditions and it is instructive to compare practice in different sections of the country. The presiding officer should secure this information and give it to his audience, but, as a matter of fact, he seldom does.

Lost motion is the bane of every convention and it is the duty of the chairman to make every minute count. Long papers, filled with statistical matter, are often read in full. They may contain a wealth of information, but such data cannot be grasped during a hasty reading. They must be taken home and carefully studied, yet papers of this sort are often presented and no time limit is placed on them. It is much more effective for the author of a highly technical or statistical paper to present only a summary of the conclusions, leaving the full paper to be examined at leisure. The officers should exercise a censorship over the papers to be read and, happily, such is now the practice in many organizations. It deserves to be generally followed.

Discussion from the floor is one of the most valuable features of every technical meeting, and it is here that the presiding officer can be of most value. If he simply asks, "Is there any discussion?" there is not likely to be enthusiastic response. Some chairmen, however, have a happy faculty of prefacing the discussion with a few remarks, emphasizing the features of the paper and those points on which there is most likely to be difference of opinion. The tactful chairman, by such a procedure and by calling on those who he knows are especially qualified to discuss certain phases, can cause discussion to sprout in soil apparently barren.

While discussion should be fostered, it should not be allowed to run wild. The presiding officer must tactfully yet firmly keep the speakers within proper bounds and not let them wander from the subject. The least he can do is to set a time limit, if none is provided in the convention rules, for each discussion.

These, apparently, are but small points, yet their continual neglect is responsible for the slipshod fashion in which many engineering meetings are run. Lax procedure is discouraging to those accustomed to businesslike methods and has a tendency either to deter people from attending the convention at all or of sending them to the corridors and on junkets rather than encouraging them to participate in the serious features of the meeting. A good chairman, after all, is but an incident of the convention, but he is of so much importance that his ability largely determines whether the convention shall be stamped as successful or not.

A Remarkable Public Works Report

JUST a little more than a year ago, in the issue of Nov. 8, 1913, the Engineering Record commented upon the remarkable first year record of the reform administration in the Department of Public Works, of Philadelphia, during 1912. Mayor Blankenburg had selected as head of the department Morris L. Cooke, an engineer who had demonstrated his ability for administrative work by the successful reorganization of many private businesses. Much was expected of him by those familiar with his professional record—and they have not been disappointed. There has come to hand recently the director's formal report on the second year's work. The document is so unusual that it deserves especial attention.

One of the most striking features of the report is its very frank criticism of conditions which hamper the department. In this respect it differs decidedly from the usual municipal document. The city council is not spared and specific instances prove that there is good basis for complaint. In one place in the report it is distinctly stated that the type of architecture of municipal structures cannot be expected to improve while the present consulting architect—mentioning him by name—is retained.

In general it may be said that the keynote of Mr. Cooke's policy has been to administer city affairs along businesslike lines. The selection of employees, the keeping of accounts, the letting of contracts, the recognition of the human elements by attempting to build up an esprit de corps in the department, all follow the lines of approved practice in the industries and commercial organizations.

While many features of Mr. Cooke's report deserve discussion, space forbids extended consideration. Two points, however, one a very important one and one of minor character, have a special interest.

There is no one cause which has contributed more to the success of the work accomplished than the employment of experts. During two years over sixty such advisers have been consulted, despite the fact that every possible obstacle is placed by the city council in the path of securing expert advice. As a result some experts have given their services free, while in most cases payment has been from a fund privately subscribed. Such a condition is commentary indeed upon the capacity and intelligence of the city council.

A less important point, but one of peculiar interest to this journal, because it has long insisted upon it, is the change in the method of writing the bureau reports. Every effort has been made, Director Cooke states, to make these annual reports both readable and of use to the city. The tabular matter has been reduced to that which has some significance to the general public. The heads of the bureaus have been encouraged to express their own views on work done and planned, in the hope that it will stimulate public interest and discussion. Where it has seemed wise to publish details such figures as are given have been placed in the appendices wherever possible. Mr. Cooke concludes as follows: "The general public has very largely stopped reading such public documents as these, mainly because they are forced to wade through an interminable quantity of records in order to get at the salient points. We hope each year to make some further improvements along these general lines." This practice is in accord with the frequent comment in this journal and with the ideas advanced in the paper by A. N. Johnson in last week's issue. Mr. Cooke's report, it may be noted, is an excellent example of the methods of presentation Mr. Johnson advocates.

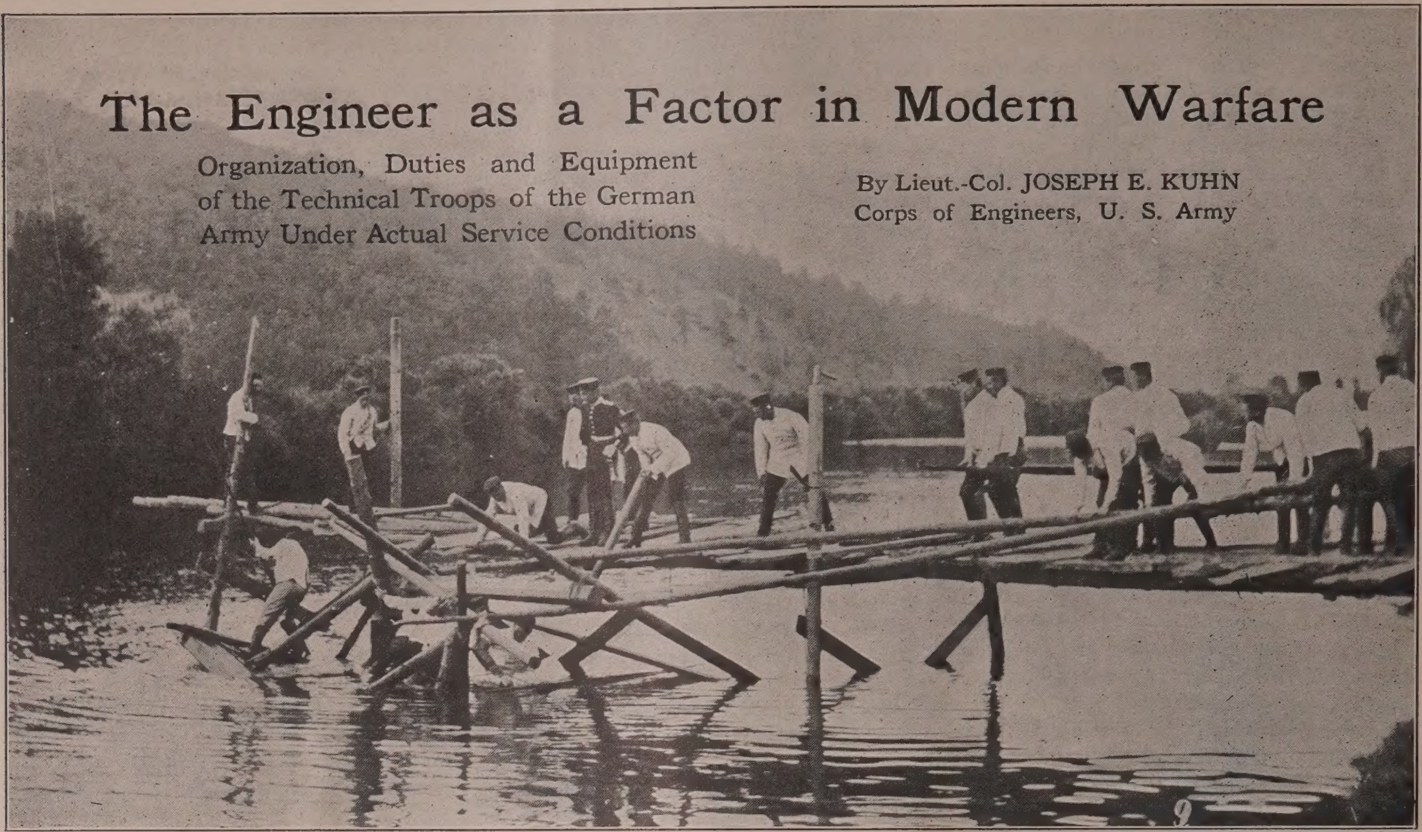
Despite the progress made the director does not hold that the achievements should cause any special satisfaction. He says: "Upon further acquaintance with the work of this department the conviction grows that over a large part of the field of municipal engineering we can only be said to have made a good start. Before we consider our designing, constructing and operating efficiency as on a basis comparable with private enterprises many improvements must be made. Any elation which those responsible for the progress made by this department in the last two years might justly feel must necessarily be tempered by the thought that practically all of the methods and mechanisms we are now using will almost surely give place in the near future to something better."

Entertaining such a feeling about the work it is to be expected that still further achievements will be credited to the present administration.

The Engineer as a Factor in Modern Warfare

Organization, Duties and Equipment of the Technical Troops of the German Army Under Actual Service Conditions

By Lieut.-Col. JOSEPH E. KUHN
Corps of Engineers, U. S. Army

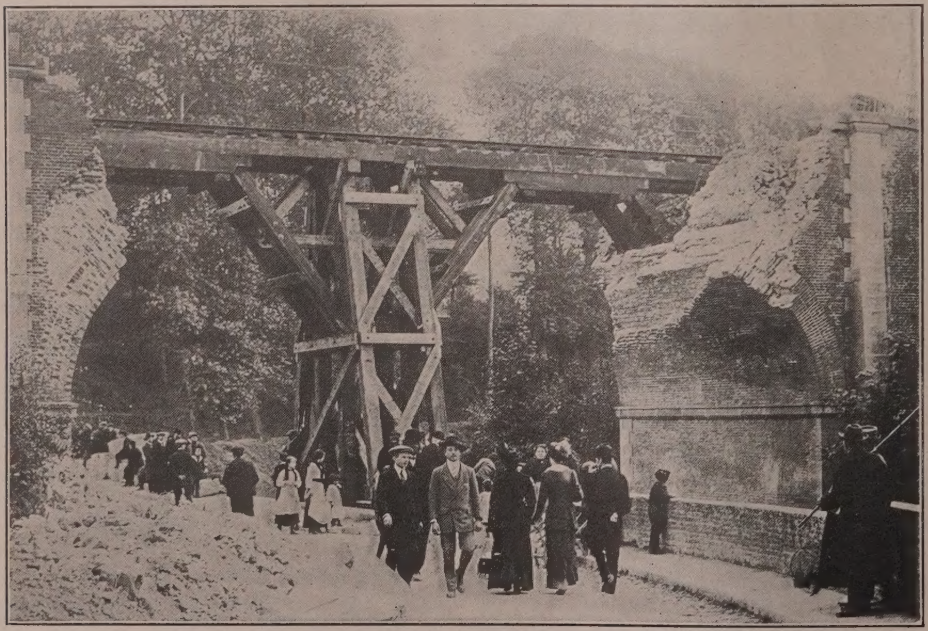


GERMAN ARMY ENGINEERS ERECTING BRIDGE OVER A STREAM IN BELGIUM

WHILE the titanic struggle now raging in Europe is engaging the attention of the whole world, it may be of interest to readers of the Engineering Record to learn a little of the part played in military operations by the engineer's art. In a matter so serious as war, involving the very existence of states, it is inevitable that advantage will be taken of every resource of the arts and sciences and that engineering must obviously play an important role. In fact, the very character of warfare is profoundly affected by the achievement in the several fields of engineering. To cite a few instances only, warfare on the scale now witnessed in Europe would be impossible without the transportation facilities of the railroads and of mechanically propelled vehicles, nor could such enormous masses of troops be directed and controlled by one master mind without the aid of the telephone, telegraph and wireless. The achievements in metallurgy and machine design have produced the modern gun and rifle which have profoundly influenced battlefield tactics.

CLASSES OF TECHNICAL TROOPS

It must be plain that the engineer's art plays no inconsiderable role in the equipment and transportation of armies, but the part played during actual campaigning, with its incidental marching and fighting, is perhaps not quite so apparent. Briefly stated, campaigning consists in overcoming obstacles, sometimes natural, but more often due to the enterprises of the enemy. On the march the principal obstacles are poor or impassable roads; in battle it is the fire of the enemy. While it is the duty of every soldier, irrespective of his branch of service, to assist in overcoming the obstacles encountered in campaigning, certain obstacles can best be met by men with technical training and technical equipment. To meet this situation, the organization of all modern armies provides for contingents of technical troops constituting collectively the engineer troops. These technical troops are frequently differentiated as pioneers, pontoniers, railway troops, telegraph sections, etc., according to the special technical work entrusted to them.



REPAIRS TO RAILWAY BRIDGE WHICH HAD BEEN DYNAMITED

In the German Army, which may be taken as an example, the various technical duties in time of war are divided between two classes of troops, one the corps of pioneers and the other the communication troops (Verkehrstruppen). The former are strictly combatant troops, who march and fight with the infantry, cavalry and artillery. The latter have charge of the railways, telegraph, aircraft and mechanical transport in the immediate sphere of military operations. As the limits of this article will preclude any extended description of the duties, equipment and organization of all the different classes of technical troops embraced in the German military system, only the pioneers will be further considered.

ORGANIZATION AND EQUIPMENT

To each army corps, which is the largest permanently organized unit, there is assigned normally one pioneeer battalion of three companies each having a war strength of 250 men. One company is attached to each of the two divisions constituting the corps, while the third company is under the direct orders of the corps commander. All pioneer companies are armed and equipped as infantry in addition to which each man carries on his person a portable work tool, there being 45 picks, 110 shovels, 58 axes, 22 hatchets with a few other tools to each company. Besides the portable tools carried by the men each company has a four-horse tool wagon carrying an assortment of digging and cutting tools and a varied assortment of supplies, such as rope, wire and nails and a two-horse demolition wagon carrying about 900 lb. of explosive.

Additional equipment for the use of the pioneer companies is found in the bridge trains accompanying each division and corps of the army, the personnel of which is furnished from the train, except that the corps bridge train has attached to it a detachment of pioneers for the care of the equipage. The divisional bridge train comprises 15 wagons carrying pontons, trestles and flooring, sufficient for constructing 36 yd. of bridge. The corps bridge train comprises 34 wagons for carrying bridge equipage, sufficient for 136 yd. of bridge. By combining the material of the divisional and corps bridge trains each army corps of about 25,000 men has sufficient material for the construction of 208 yd. of normal bridge. The bridge trains do not ordinarily march with the pioneer companies but form part of the divisional and corps trains, being brought up when occasion requires.

TROOPS DIGGING TRENCHES IN ANTICIPATION OF ATTACK

Still further technical equipment for the use of the pioneers consist of the searchlight sections attached to each army corps. The latest pattern of searchlight equipment is a horse-drawn electrical projector carriage, the motor and generator being carried over the front axle and the projector with its telescopic mast and cable reels being carried over the rear axle. When in use the projector axle is uncoupled from the generator axle, enabling its light to be set up at any point within a radius equal to the length of cable.

In addition to the foregoing normal organization and equipment of pioneer troops for army corps and divisions special fortress and siege units of pioneers are formed on mobilization as occasion requires. These units are ordinarily regiments of two or three battalions equipped with a pioneer siege train carrying intrenching, mining and other tools, building materials, electric searchlight plant, explosives and storming apparatus. The organization of the siege train varies with the nature of the operations in view.

The recent tendency in the German Army is to increase the proportion of pioneers assigned to corps and divisions and certain corps have already had their contingents of pioneers doubled, being provided with a regiment of two battalions.

The pioneers are selected from recruits possessing a knowledge of mechanical trades such as carpenters, smiths, masons, miners, riggers, or such as have knowledge of boating and boat building, the latter in view of the importance of bridge operations. The period of training of the pioneers is 2 years, the same as that of the infantry. Besides being well grounded in the duties of an infantry soldier, the pioneers are thoroughly taught their special technical duties, the principal of which are bridge building, fortifications and demolitions.

DUTIES OF PIONEER CORPS

The crossing of an unfordable stream in the face of opposition by an enemy is one of the most difficult and dangerous of military operations and one in which the pioneer plays a most conspicuous part. Upon his technical skill, nerve and daring depends the success of an attack or the safety of a retreat, and when the undertaking is handicapped by swift currents and by the fire of the enemy, the pioneer's task is indeed a most trying one. In European terrain, intersected by numerous streams and canals, bridging operations are of common occurrence in campaigning and, even if there were no other engineer-

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BUILDING RAILROAD TO BY-PASS PORTION OF MAIN LINE BLOCKED BY LOCOMOTIVES TURNED LOOSE AT FULL SPEED BY ENEMY ing features in war, these operations alone would call for technical troops and equipment.

During an advance a section of pioneers always marches with the advanced guard to repair or improve roads and to remove obstacles created by the enemy. During an attack, especially on fortified positions, pioneers accompany the advance of the storming columns for the purpose of removing obstacles and clearing the way. In this work high explosives play a leading part. On the defensive the pioneers assist in the work of fortifying the ground, clearing the foreground of obstructions so as to permit of a clear field of fire, constructing obstacles, such as wire entanglements and mines, building or improving the communications in rear to permit of the ready movement of troops and artillery and erecting special structures, such as bombproofs, observing stations, dressing stations for wounded, etc. If villages or towns are to be defended, the pioneers loophole the walls, barricade streets, and provide direct communications inside the lines by breaching openings through walls and buildings.

During retreats the pioneers are charged with blowing up bridges, damaging railroads, destroying stores and practising similar operations designed to delay the movements of the enemy. As time is the all-important element high explosives constitute the principal reliance. The best military explosives are those which are of solid form and of shapes which will permit of their being rapidly and conveniently assembled into larger charges. Picric acid or trinitrotoluol in the form of blocks or cylinders are the most suitable explosives and the ones almost universally employed for military purposes.

SAPPING DURING SIEGES

In sieges the duties of the pioneers become of paramount importance. Here the trench work must be largely done by them by the slow and tedious method of sapping which consists in the excavation of the trench at its head in a manner similar to that of driving a tunnel. When the enemy's forts are reached, mine shafts and galleries must be driven under them and the works finally blown up. It is hardly necessary to state that this work is exceedingly dangerous under the concentrated fire of the enemy and his counter-moving operations and that the casualties of the pioneers will be heavy.

The foregoing reference to the duties of the engineer troops in campaigning by no means exhausts the list. It must be apparent that they have no easy task, for they must not only march and fight with the other troops, keeping abreast of them at all times, but must frequently execute laborious tasks for the benefit of their comrades, tasks which, though highly important, are less romantic and glorious than the charge and the hand-to-hand encounter.

The fundamentals of military engineering do not differ from those governing civil practice. There is, however, this difference—the results sought are as often destructive as they are constructive, and economy in a financiel sense must yield to economy of time, which is the all-governing consideration in military operations. The military engineer is, however, handicapped in his operations by an absence of all the labor-saving and efficient machinery and the variety of adaptable material at the disposal of the civil engineer. He must, therefore, be all the more resourceful in turning to his purposes the scanty resources immediately at hand. One material he can always find in unlimited quantity and that is earth which, in fact, constitutes his principal building material supplemented by whatever timber, wire, stone that may happen to be handy. One thing in which the military engineer has an advantage over his brother in civil practice is that he need not worry over property rights. Under the stern law of military necessity he is free to help himself to anything which will answer his purpose and without fear of consequences.

Flood Prevention for the Lower Mississippi

Establishment of a Stable River Channel Protected by Revetments Against Erosion Is the Complete Solution of the Problem

By T. G. DABNEY

REGULATION and control of the lower Mississippi River present two aspects—the prevention of destructive overflow and the development of the navigation possibilities. Taking into consideration these points, as well as the phenomena peculiar to this river, the writer proposes to present, as briefly as may be, a somewhat comprehensive discussion of the entire problem.

In studying the physical phenomena presented by the river as factors in the problem, there appear but two major features that demand the attention of engineers, which are:

1. The instability of the inclosing banks of the river and constant changing of its shorelines, resulting in continuous shifting of the line of flow, and constant contributions of enormous masses of earth, which tumbling from the banks into the current are so disposed as to contribute directly and largely to impeding the passage of the flood flow down the river.

2. The tendency of the river channel under natural conditions to become so encumbered with material robbed by the current from its own banks by vigorous erosion, and this in combination with a natural deficiency of cross-section, that the discharge capacity is limited to about one-half or less of the maximum volume of flood flow, with the result that the excess flood water is distributed over the valley on either side of the river, causing great destruction. This condition has necessitated the raising of the river banks by artificial means to an elevation sufficient to contain the whole volume of flood water within the channel, which is done by building continuous lines of levees near the banks of the river. The caving of the banks into the river operates at once to increase the height of the floods to be restrained by the levees, and at the same time to render the situs of the levees unstable. Portions of the levee lines are often engulfed, and the restoration of broken lines by building portions of new levee around the gaps so made becomes necessary—a task that grows progressively more costly and more difficult.

BANK REVETMENT VS. LEVEES

In looking at the whole problem from a strictly engineering point of view, to wit, the regulation, control and full development of the lower Mississippi River to serve most fully the needs of man, it is obvious that the fundamental and primal factor to be taken in hand by engineers is that of creating stable and permanent shore lines and a fixed line of channel flow, which is a condition precedent to further treatment; and from this strictly engineering view the building of restraining levees takes a secondary place.

It may be a matter for interesting speculation that while the Mississippi River problem has been under the consideration of engineers for many years, no clear-cut and definite plan for its permanent solution has ever been put forward to claim a general recognition. The explanation is that environing conditions have forced and controlled the lines of effort heretofore made to combat the destructive energy of the floods, resulting in temporizing devices instead of works of permanence, with consequent enormous waste of money and energy, as well as time, to meet by temporary means immediate and pressing demands for protection from overflow. A man must build a house to protect himself from the weather; but it may so happen that the storms come so hard and frequently that he must resort to an umbrella for lack of time and means to complete his edifice.

The immediate need of levee protection from river floods presented itself as a compelling fact to early settlers along the banks of the river, long before the Mississippi River problem in its larger aspects came under the view of engineers. The progressive invasion of this territory when in a wilderness state by individual settlers occasioned the progressive extension of levee protection by crude methods as an imminent necessity. This gradually developed into regular systems of levee building on a more scientific basis, as the growing resources of the riparian territory permitted. In this way levee protection against floods became the dominating factor in the practical treatment of the Mississippi River problem, before the more fundamental feature of channel correction and regulation came in for serious consideration—as an adjunct, at least in the view of the law makers, to the maintenance of levees. It is only more recently that the fundamental importance of bank protection has forced itself into recognition by the authorities who control the treatment of the river problem, and such recognition even yet is less compelling than its importance demands.

FUNDAMENTAL PRINCIPLES

The following propositions, in the nature of an analysis of the physics and phenomena of the lower Mississippi River, are here laid down as pertinent to this discussion.

1. The bed of the river is not being gradually filled by sedimentation as a result of confining the flood water by levees, a popular fallacy that widely prevails.

2. The tributaries of the lower Mississippi River do not affect its flood regimen to a significant degree otherwise than merely by the volume of water contributed to its flow; and practically the same volume of suspended matter that enters the channel at the head of the lower valley is carried all the way down and discharged into the Gulf.

3. The caving of bank material into the river channel by current erosion is the one "original sin" that must be corrected before there can be any satisfactory solution of the problem of flood control and channel rectification.

4. It is competent to establish lines of levees along the opposite banks of the river, capable of containing between them the greatest floods that are to be anticipated; but without the prevention of bank erosion the necessity must constantly prevail, of replacing considerable portions of the levee lines engulfed by caving banks, an operation which, as already stated, grows progressively more difficult and costly, and which, as a system of flood protection, must ultimately reach a "breaking-down point," as a result of cumulative obstacles and difficulties.

5. The great masses of earth material eroded from caving banks contribute in a direct way and to a material extent to lessening the discharge capacity of the channel, increasing the elevation of the flood plane and creating obstacles to navigation.

GEOLOGY

The widespread popular fallacy that confinement of the Mississippi floods between levees, preventing the distribution of matter in suspension over the adjacent lands, must result in filling the river channel by sedimentation, is based upon another fallacy, that all the material which constitutes what is miscalled the "alluvial valley" of the Mississippi River was placed where it is by the agency of the river. This involves the further false idea that the flood waters of the Mississippi are burdened with prodigious quantities of suspended material that, if not dropped over the surface of the country, must necessarily find lodgment in the bed of the river. The logic is correct, if the premise is true.

The truth of the matter is, according to the best geological authorities, that the material composing this so-called "alluvial valley" was in its present place long before the Mississippi River, as we now know it, came into existence. The "Mississippi Embayment," prior to the developments that resulted in modern conditions, underwent various mutations in the elevation of its floor. Vertical movements both down and up occurred, presenting a complicated series of geological phenomena, now difficult to trace with definiteness; but the fact seems well established that immediately prior to the activities which produced present conditions this embayment had been filled with materials, partly fluviatile, partly estuarian, to an elevation at least as high as the bordering "loess," or "bluff formation," the remnants of which now mantle the marginal hills on the east and west of the valley. This formation was then superposed upon what constitutes the present surface, all the way across from hills to hills, and, in general, was composed of "grist from the glacial mills" that had been in activity in northern regions.

At this period large volumes of liberated glacial water poured down through the "trough," scouring out and carrying into the Gulf the great body of the more yielding "loess," and, in the language of Dr. E. W. Hilgard, "planed down the surface to the resistant buckshot floor," which now constitutes the exposed surface of the so-called "delta," except where covered by relatively small deposits of river alluvium, on and near the banks of the main stream and those of its various distributaries.

By subsequent action the modern Mississippi River carved for itself a channel, down through the estuarian deposits, and in some cases into the underlying tertiary formation, since which development energetic erosion of the banks has caused a shifting of the river channel, eastward and westward over a comparatively narrow belt, 12 or 15 mi. wide, marked by a partial covering of modern alluvium, which thins out toward the margins.

LITTLE MATTER IN SUSPENSION

The prevalent idea that vast quantities of eroded material from the northern highlands is brought down with every flood, and under natural conditions is deposited over the entire surface of the lower Mississippi valley, is not supported by the facts of observation. In the deepest swamps in the interior of the valley, which are overflowed to a depth of from 5 to 20 ft. during flood seasons, show no evidence after the water has subsided of any appreciable or discernible recent deposits of silt. We find the same "buckshot" clay on the surface, and the roots of trees displayed above the surface of the ground unchanged, and without a covering of alluvium. Moreover, the numerous old "cutoff" bends of the river, lying along on either side and directly in the path of the flood flow, and which are ideal "sediment traps," have remained for centuries unfilled by river deposits.

BANK EROSION

The current erosion of the river banks is the great disturbing factor which has enormously increased the difficulty and cost of protecting the riparian lands from overflow, and has prevented a realization of the possibilities of navigation facilities that the river is capable of developing. It is, therefore, of vital importance that this disturber shall be eliminated as rapidly as may be practicable, by the application to the caving bends of willow mattress revetment, which experience approves as entirely effective for the purpose.

As an illustration of the magnitude of this disturbing factor, a case may be cited which recently came under the observation of the writer, in a locality near the north boundary of the State of Mississippi. In a caving bend 11,000 lin. ft. in extent, the superficies of 107 acres of cultivated land was carried away in a single season by current erosion, this having a computed content of more than 10,000,000 cu. yd. of earth formation. This great mass of material, partly rolled along the bed of the river and partly carried in suspension, was in part deposited on the flank of the current to build out the opposite "bar," and in part was dropped on the shoal "crossing," or submerged dam, extending across the channel at the foot of the bend, where the "thalweg" diverges from one shore and crossing the channel diagonally impinges upon the other shore, producing a broad and shallow expanse across the whole width of the river. The "crossing" is thus built up to an elevation much above the low-water plane, during the rise of the flood, by material eroded from the bank a few miles above, and constitutes at once the great obstacle to navigation, and an obstruction to the flood flow of the river. As the flood recedes the steepening of the slope across the shoal expanse causes the top story to be razed and carried into the pool below, and when the river has again fallen to the low-water stage we find the bar with a maximum depth of 4 or 5 ft. of water over it.

CONSTANT DREDGING TO MAINTAIN NAVIGATION

It is across these bars that the Federal authorities have for the past eighteen years endeavored to maintain navigable water by the use of hydraulic dredges, a process that must be repeated every low-water season on all the numerous crossings. In the nature of the case this is an unending task, which can never reach a definite goal, but as a temporary recourse it is both useful and necessary for the relief of navigation pending the permanent regulation of the river channel.

The process of local shifting of material is constantly going on in all the bends from the upper end of the lower valley down to the foot of the "steep-slope division" of the river, which is in the locality of the Red River. This is also the head of the "flat-slope division" of the river, in which along its 300 mi. to the mouth the slope is very flat, with consequent low velocity of flow and absence of bank caving to a significant degree. The channel is everywhere very deep, with no shoals, on account of the absence of bank caving, and is comparatively symmetrical in section.

In the steep-slope division above active caving is going on during every flood season in all the concave bends, the displacement in any locality being represented by a replacement of material from localities further up the river. There is a general down-stream movement of the shifted material by successive displacement and replacement, and when the movement reaches the head of the "flat-slope division" of the channel the general resultant is a volume of suspended matter consisting of finely comminuted particles, which residuum is carried through to the Gulf, and in volume practically equals the quantity of sedimentary matter brought into the main trunk by the several tributaries.

STOPPAGE OF EROSION ESSENTIAL

It is obvious that with the prevention of all bank caving there must be a cessation of the supply of material with which the river builds up its submerged dams and obstructs its flood flow, with the further obvious result of lowering its flood plane. It is also evident that with the line of flow fixed and unchangeable, and the current unburdened of the masses of earth robbed from its banks, the flood energy must be perpetually exerted to the removal of obstructions in its path instead of continually rebuilding them, a process that must result in both increasing the navigable depth of the river and in simplifying the work of flood protection by lowering the flood plane.

If the levee system is perfected without stopping bank erosion, this effect must ensue which has not been adverted to; with a greatly increased volume of flood flow between opposing lines of levees, nature is sure to demand a wider channel, which means increased quantities of eroded material to be transferred from the banks to the channel, serving to accentuate the present channel difficulties instead of diminishing them, and adding to the precariousness of levee locations.

One beneficent effect of bank protection which has not been accorded due recognition is that bank stability will make it feasible to erect and maintain permanent freight-handling facilities along the lower river, the lack of which is one of the heaviest handicaps on present river traffic. The two large elevators built in Memphis and Vicksburg in the early seventies of last century were both "put out of commission" by caving banks several miles distant from their sites, which caused the building up of wide battures in their fronts.

COST OF PROTECTING CAVING BANKS

Many widely varying estimates have been put forth of the cost of revetting all the caving banks along the river below Cairo, some of which were absurdly exaggerated.

In the report of the Mississippi River Commission for 1896 a summation was made of the extent of all caving banks between Cairo and the mouth of Red River requiring revetment. The linear measurement totaled 406 mi. An estimate was made in that report of the total cost of bank revetment between the above terminals, in which it was assumed, without warrant, in the writer's opinion, that the full length of the river channel embraced, which is 764 mi., should be taken as the measure of the length of bank to be revetted. It was here assumed in a loose way that the total length of caving bank would be increased, without assigning a definite reason for the assumption. On the contrary, it is the writer's conviction that the total length of caving bank along the river below Cairo remains practically constant; as, with an extension downstream of the region of caving at the lower end of a bend, there is a reciprocal extension of the non-caving region at the upper end.

Upon the above assumed length of revetment required, with a unit cost of $150,000 per mile, the total cost was given in round numbers at $120,000,000.

For a present estimate it is assumed that the actual length of caving bank should be taken as the basis, which, allowing for revetment since done may be accepted as 400 mi. Taking the unit cost as developed by recent revetment work at $185,000 per mile, the total estimate of cost would be $74,000,000. Add to this the river commission's estimate for auxiliary contraction works as $3,000,000, together with $8,000,000 for contingencies, the total estimate comes to $85,000,000. With timely and assured appropriations of $5,000,000 per year, this revetment work should all be accomplished within twenty years.

A REGULATED RIVER CHANNEL

A complete solution of the Mississippi River problem must present the following conditions:

1. A channel having stable banks and permanent shorelines.

2. The low-water flow over the shoal crossings regulated by auxiliary contraction works.

3. A volume of flood water flowing in the channel, unburdened by material derived from bank erosion, and comparatively free from the great load of earthy matter that is now picked up and dropped successively at short intervals throughout the steep-slope division of the river.

4. A great volume of flood water flowing with flood energy along a fixed path, its free energy perpetually exerted in the work of removing obstacles to its passage.

5. A low-water channel through shoal "crossings" having a minimum available depth of from 20 to 25 ft. at all seasons, the eroded material being distributed along the bottom of the intervening deep "pools," which in linear extent exceed that of the "crossings" in a proportion of more than ten to one.

6. A channel free from "snags," which are derived from forested shores that cave into the river, which require the incessant work of powerful snag boats for their removal, and still constitute a dangerous menace to steamboats, sinking them not infrequently.

7. The prevalence of permanent freight-handling facilities everywhere along the lower river, whereas, under present conditions all steamboat traffic is handled by the same crude, laborious, slow and costly methods that prevailed three-quarters of a century ago; and this constitutes the chief handicap in competition with railroad carriage.

8. Permanent lines of substantial levees to restrain the floods, which when completed to present standards of height and dimensions shall prove in excess of the requirements for controlling the lowered floods in a regulated channel.

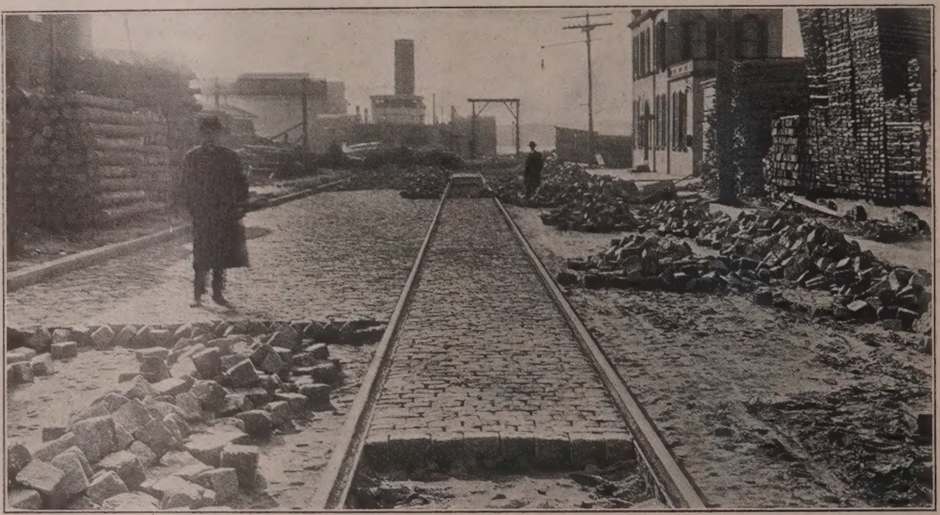
It should be noted that the low-water discharge of the river below the mouth of the Ohio is in round numbers 90,000 sec.-ft. This volume of flow, passing through a "crossing" with top width contracted to 1400 ft., and an assumed bottom width of 400 ft., with a velocity of 4 ft. per second, requires a uniform depth over the assumed level bottom of 25 ft.

THE OKLAHOMA GEOLOGICAL SURVEY has just issued a new State map. The existing maps were found to be lacking, especially as to the proper location of railroads and also of some of the smaller towns. The general procedure in making the map was as follows. The network of 30 min. in latitude and longitude was constructed as a base. On this was imposed the areas covered by the U. S. Geological Survey. The balance of the State was filled in according to the U. S. Post Route Maps of 1914. Requests for information were also made to the different county surveyors. Finally, by courtesy of the different railroad companies the surveys of sections through which they passed was added. The map is not put out as being entirely correct, as limitation of funds prevented an extensive survey.

Recut Granite-Block Pavements in Baltimore

Success Has Resulted from Removing, Breaking, Dressing and Relaying Old, Large Blocks During the Last Two Years

A LARGE area of granite-block pavement, laid according to the old specifications on streets for whose traffic modern paving science would presumably assign totally different surfaces, is Baltimore's heritage from a period when stone surfaces were thought ideal for all purposes. How to replace these pavements with more suitable ones without going to a considerable expense was the problem facing the Municipal Paving Commission when it was created in 1911. About that time, however, the economic value of the old block for repaving purposes was being investigated by the highway engineers of the Borough of Bronx, New York City, who seem to have been the first extensively to redress the blocks and make a new surface of them. A statement of the experience of the Bronx officials may be found in the Engineering Record of Jan. 3, 1914, page 24. This practice was adopted by the Baltimore commission, but only during the last two years have extensive areas been laid. The expense of removing, dressing and relaying the block has been less than two-thirds the prevailing price for new granite-block surface.



REDRESSED BLOCKS LAID ON PRESIDENT STREET, LEADING TO DOCKS

The old stones were of the usual heavy type, many as large as 14 in. in length, 6 in. in width and 8 in. in depth. The broken blocks are from 4½ in. to 6 in. deep, and those which are less than 3 in. in either surface dimension are not used.

As much of the old block was laid on streets bearing a light traffic only, little trouble is experienced because of the operations of the working gangs. From the old pavements the blocks, which are sand filled, are removed with crowbars and placed convenient to the cutters, who work in the street, producing about 225 of the small blocks per 8-hr. day. The price for redressing is about 2½ cents per block, although, as the work has been let in many contracts, this price varies somewhat. The renovated blocks are carried to the heavy-traffic streets on which they are to be used. They are then laid in transverse courses on a 6-in. 1:3½:7 concrete foundation with a 2-in. sand cushion. The joints are grouted with a 1:1 mortar, a thin coat of which is finally applied to the surface. Traffic is kept off the completed pavement for 14 days.

During 1913 there were laid of this new paving about 5000 sq. yd., and in 1914, to Nov. 1, 3900 sq. yd. Approximate costs per square yard of finished pavement for this surface are as follows: Breaking up old pavements, $0.09; recutting, $1.00; hauling, laying and grouting, $0.71; total unit cost, $1.80. As the old blocks have practically no value unless used in this way, the cost of laying the recut prisms, exclusive of foundation, may be compared with that for improved granite block, exclusive of foundation. As an average figure for the latter in Baltimore is $2.80, recutting means a saving of 36 per cent.

There still exist in the city about 750,000 sq. yd. of the old granite-block pavement, and it is planned to make similar use of this as opportunity offers. The work is being done under the direction of the assistant engineers of the Municipal Paving Commission, of which R. Keith Compton is chairman.

Use of Hydrated Lime In Dam Construction

IN building the Condit dam on the White Salmon River in Washington, 10 per cent by weight of the cement of the 1:3:5 mixture was replaced by hydrated lime. Before the lime was adopted laboratory experiments were made on briquettes to ascertain whether the strength was in any way decreased. These tests showed that such briquettes compared favorably both with briquettes made of lime and sand and those made of cement and sand. The concrete mixture used on the job was "fat, greasy and plastic" and flowed smoothly through comparatively flat chutes without separation of the mixture. The cost of the hydrated lime was slightly in excess of that of the cement replaced, but it is stated that this extra cost was made up for by the greater ease in placing.

THIRTY-EIGHT VESSELS passed through the Panama Canal during the first week of traffic after the recent slide.

Scheduling Land for Federal Valuation

Railroad Committee Presents Analysis of Problem, Offering General Suggestions Together with Three Schedule Forms

THE first report of the land committee of the President's Conference Committee created by the railroads to study ways and means of co-operating with the Government and supplying the information required for the Federal valuation has just been given out by Thomas W. Hulme, general secretary of the main committee. The committee necessarily passes over important points on which the Interstate Commerce Commission has not yet ruled, and prefers to leave many of the details of gathering the data to the individual road. What is offered is general suggestions, from which these notes are taken, and forms, the headings of which are reproduced.

In the Federal valuation the item of land is one of the most important in magnitude, also by far the most difficult to handle, of the various items that together constitute the property of the carriers owned or used for railroad purposes. It is believed that when the valuation is completed the land item will aggregate about 30 per cent of the grand total value of all the properties of all the carriers. In practically all other items there are well recognized methods by which the various elements constituting value can be measured and the value ascertained, but the land item stands in a class by itself, as elements are introduced not found in any of the other items.

The commission has not yet decided whether or not it will require the carriers to show on the schedules they prepare under the map order of Feb. 1 "a statement of the area of each parcel and the original cost of the same to date."

PRESENT VALUE

Discussions with the Land Division of the commission indicate that they have not yet determined upon a plan for ascertaining present value of the property of the carriers in the cities and larger towns, and that a part of the plan contemplated for ascertaining present value of country right of way is to have its field appraisers gather information in the field as to the assessed value of lands in the vicinity of similar character to the lands of the carrier, also sales and other data showing the ratio of the assessed value to full value, and also to secure local expert opinions. When the field information has been collected the land attorney of the commission for each district will use such information in ascertaining the value of the lands of the carrier. As used throughout this circular "naked land value" means the value for general purposes, and does not include value for railway purposes, severance and other damages, improvements and any and all other elements of value for which a carrier must pay, nor does it include expense of acquisition. The naked land value having been ascertained in the manner set forth, the next step toward producing present value is to ascertain the excess that would be paid by the carrier covering the excluded items above described.

In the case of properties acquired so long ago, or where the conditions have so changed that original cost is of little or no value in determining present value, or where there are no records of original cost, the Railroad Land Committee believes that the amount of this excess which the carrier would have to pay in purchase or condemnation can only be arrived at by an intelligent use and application of the data derived from actual purchases made by the carriers of late years where their records afford complete information. The plan is to segregate the price paid by the carrier into two parts, one that portion of the purchase price representing the value of the naked land for general purposes at the time of acquisition, the other representing the damages, improvements and all other elements of value for which the carrier paid. When the data are complete they will show the excess paid by the carriers over such naked land value in acquiring property all over the United States and under

Schedule of Property acquired for______

by the______Railway Co. in State of______

First purchase made______, last purchase made______

Expense of Acquisition not to be included in this Schedule

Deed				GRANTOR	Character of Title	Acres	Purchase Price		Naked Land Value ascertained by				Difference between				REMARKS
No.	Date								"______Method"		"______Method"		Purchase Price and "______Method" Value		Purchase Price and "______Method" Value		
	Mo.	Day	Yr.				Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	

FORM A—FOR ASSEMBLING DATA FOR DETERMINING DIFFERENCE BETWEEN PURCHASE PRICE AND NAKED LAND VALUE

Schedule of Property acquired for______

by the______Railway Co. in State of______

First purchase made______, last purchase made______

Expense of Acquisition not to be included in this schedule

Deed				GRANTOR	Character of Title	Acres	Purchase Price		Assessment entire tract of area of which right of way formed a part				Ratio assessments to Actual Value	Naked Land Value per Acre *	REMARKS
No.	Date														
	Mo.	Day	Yr.				Per Acre	Total	Year	Assessment	Acres Assessed	Assessment per Acre			

*The amounts shown in this column are to be copied into the column on Form A headed "Naked Land Value ascertained by Assessment Method—per Acre."

FORM B—FOR USE IN ASSEMBLING THE ASSESSMENT DATA TO BE ENTERED ON FORM A many different kinds of conditions. The committee has prepared Form A for the compilation of these data, and the following instructions for its use.

SEPARATE SCHEDULES FOR EACH PIECE OF WORK

A separate schedule should be made of the property acquired for each piece of work, whether it be a branch line, a new main line, a line change or terminal property. Property for which no direct consideration was paid should be shown on the schedule, but in the column "Purchase Price" should be written "No direct consideration," and no other entry should be made on the schedule opposite the item, as it will be apparent that otherwise an incorrect result would be produced. It is not expected to prepare a schedule covering every small isolated purchase, as the value of the data in such cases might not equal the cost of their preparation, but each carrier, knowing the purpose for which the data are to be used, can determine for itself the extent to which it should prepare these schedules.

The column "Purchase Price" should include not only money paid by the carrier, but the money value of any work done or expense incurred by the carrier as a part of the consideration for the conveyance, making proper explanation of such cases under "Remarks" or upon exhibits attached to the schedule. It must be borne in mind that frequently the money paid is only a part of the true consideration; the carriers in many cases obligate themselves to provide roads and road crossings, cattle and other stock passes, bridges, drainage and irrigation ditches and pipe lines, and to remove and relocate buildings, etc. Diligent search should be made for all cases of this character and the amount of expenditures connected therewith ascertained and included as a part of the consideration, unless the expense was charged to Road Account, in which event it should not be included in the consideration but stated and explained under "Remarks" upon the schedule. When it is known that an expenditure of this character was made, but the amount thereof cannot now be ascertained, that fact should be noted. All data connected with such expenditures should be carefully preserved for substantiating the charge.

METHODS OF ASCERTAINING VALUE

There are various methods by which the naked land value may be ascertained with a reasonable degree of accuracy. Wherever practicable, two methods should be used for each schedule, one to act as a check upon the other. The commission will undoubtedly make a thorough check of the information and the carrier should be prepared to prove the substantial accuracy of results shown by the schedules.

Assessment Method.—Naked land value ascertained by the assessment method is accomplished by taking the assessment of the entire tract without improvements of which the right of way formed a part for the year in which the property was purchased, and dividing by the acreage, the assessment per acre being thus produced. The next step is to determine the ratio of assessed value to actual value, which should be ascertained from the best source obtainable. The assessments having been ascertained, also the ratio which the assessments bear to actual value, it is then a simple calculation to produce naked land value as ascertained by the assessment method. Form B may be used for scheduling the assessment data.

Opinion Method.—When this method is used the opinion of local parties carefully selected for their knowledge of local values should be procured of the naked land value at the time of acquisition of the entire tract of which the property acquired by the carrier formed a part, or upon such value of land of similar character and value in the vicinity, without including severance or other damage or any of the other elements entering into the price paid by the carrier.

Sales Method.—Sales are an important factor, and there will doubtless be districts where there have been sufficient sales of lands in the vicinity, and of sufficient similarity in character and value that the naked land value at the time of acquisition can be determined therefrom with a reasonable degree of accuracy; therefore sales may be used as a separate method, as well in working out and supporting other methods. Where a carrier uses this method it should be careful to analyze correctly the sales information and set forth in an exhibit attached to Form A the data used with full explanation.

Schedule of vouchers covering Expense of Acquiring property purchased

by the .... Railway Co. for ....

First purchase made ...., last purchase made ....

At the end of the Schedule following the Total of the expenditures, an entry should be made reading "Total purchase price of the property of which this schedule represents the expense of acquisition, without including said expense of acquisition, was $.. Ratio of expense of acquisition to purchase price ....%."

VOUCHER No.	CHARACTER OF EXPENDITURE	AMOUNT

FORM C—SCHEDULE OF VOUCHERS COVERING EXPENSE OF ACQUIRING PROPERTY

Enhancement Method.—The U. S. Supreme Court in the Minnesota rate case recognized that carriers were entitled to whatever enhancement there had been in the value of their lands over their original cost, and this suggests that where the amount of the enhancement in value of similar adjoining property between the date of the acquirement by the railway company of its property and the present date can be ascertained with reasonable accuracy the carrier may claim the same rate of enhancement. It is obvious that this method cannot be used where the original right of way was granted or donated, or where the original cost is not known, or where the right of way was acquired so long ago that it is impossible to determine with reasonable accuracy what the enhancement in values has been. While Form A has not been prepared to cover this method it can be used up to and including the column headed "Purchase Price" and an exhibit attached thereto setting forth the enhancement in values claimed and the reasons and authority therefor. It will probably be found more practicable in using this method to determine the enhancement by districts or zones covering a territory in which the amount of the enhancement has been found to be substantially equal.

It is evident that the difference between naked land value and purchase price will vary considerably in different localities and under different conditions. Therefore, in order that the scheduled information may be intelligently used, a statement in the form of an exhibit should be attached to each schedule explaining the character of the district, the extent to which it was already served by railroads, the extent to which condemnation was resorted to, and anything else that will serve to show whether the prices paid by the carrier were high, low or normal.

COMPLETE ANALYSIS DESIRABLE

These instructions do not require complete segregation of purchase price into all of the various elements composing the same, such as naked land, damages, improvements, higher value for railroad purposes, and higher cost on account of compulsory character of the transaction, but such information would be of very great value, and wherever a carrier has the data to make such segregation in whole or to a greater extent than is outlined here, it is requested to do so, and a form adapted to the purpose will be furnished upon request.

In order that proper allowance may be made for this character of expense the carriers are requested to prepare schedules on Form C of all vouchers covering expenditures of this character made in recent years.

It is expected that the schedules will cover all of the expense of acquisition that has been charged to the right-of-way account, and it may be that some of the carriers have charged to the account a proportion of what might be termed overhead expense covering the service of the executive, legal, engineering, accounting, treasury and other departments, rendered in connection with the acquisition of the right of way.

GROSS OPERATING REVENUES FOR AUGUST on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1175 per mile, showing a decrease of $69 or 5.6 per cent as compared with August, 1913. Operating expenses were $789, showing a decrease of $67 or 7.8 per cent. Net operating revenues were, therefore, $386—a decrease of $2 or 0.6 per cent. The operating ratio was 67.1 per cent, as compared with 68.2 per cent in August, 1913, and 64.0 per cent in August, 1912. Considering the three main districts, the respective ratios for August, 1914, and August, 1913, were as follows: Eastern district, 67.3 and 70.0; Southern district, 74.2 and 74.2; Western district, 64.5 and 65.5.

Fourth American Road Congress

Abstracts of Some of the Papers Presented at the Annual Meeting Held in Atlanta, Georgia, November 9 to 14 — Subjects Include Maintenance, Administration and Economics

Road Economics

By J. E. PENNYBACKER

Chief of Road Economics, U. S. Office of Public Roads

IN that branch of economic science which treats of the cost and use of the road as a public utility there are ten axiomatic principles:

1. All who share in the benefits of road improvement should share proportionately in the burdens.
2. The degree of improvement should be proportionate to the traffic importance of the road improved.
3. The rate of payment or the rate of accumulation of the sinking fund on any public debt contracted for road improvement should approximately equal the deterioration of the improvement.
4. Road building and maintenance comprise work requiring special qualifications on the part of those who direct it.
5. Responsibilities should be definite as to persons.
6. Continuous employment is more conducive to efficient service than intermittent and temporary employment.
7. The specialists who direct road work should be appointed instead of elected; and they should hold office during efficiency instead of for a fixed term.
8. No road is wholly permanent; at best it requires continuous upkeep, for which financial and supervisory provisions must be made.
9. Cash is a much more satisfactory form of tax than is labor.
10. All agencies at the disposal of the State, capable of use in works of public improvement, should be so used, rather than in such commercial production as would conflict with private enterprises.

APPLICATION OF PRINCIPLES

The practical application of these ten axiomatic propositions does not involve intricate or impracticable procedure. Under the first proposition the country road is no longer a mere local utility. Legislation should, therefore, be framed so as to provide for city taxation in aid of country road improvement. Automobile owners should individually pay a material portion of the cost of our public roads.

It is now generally believed that four-fifths of the traffic of this country is carried on one-fifth of the road mileage. It should be manifest that the most heavily traveled roads should first receive attention and should be improved in the most substantial manner. The relative cost of a determination of the amount of traffic would be almost negligible if incurred as a preliminary to a large outlay for actual construction.

The third proposition is intended to prevent the incurring of a debt which will outlive the utility which it was designed to create. Location, if intelligently made, should be permanent; likewise all reduction of grades. The drainage features, if honestly and efficiently constructed, should be reasonably permanent. The road, except under extraordinary conditions, should, therefore, be considered reasonably permanent as to these features. As a general rule, the foundation of a road should not require renewal if the road is subjected to adequate and continuous maintenance. In general the permanent features would average at least 50 per cent of the total cost, so that, if the other 50 per cent must be figured as perishable and subject to renewal, the debt should not cover a period longer than twice the length of this perishable portion.

KEEP POLITICS OUT

The seventh proposition, which calls for appointment rather than election and for the holding of office during efficiency instead of for fixed terms, is designed to attract to the work men who look upon road-building as a life profession or occupation. A good engineer may be a very poor politician and a good politician may be a very poor engineer, but in a contest in which votes are essential the good politician will usually defeat the good engineer, although the position requires engineering ability rather than political ability. Do not spoil a good highway engineer or superintendent by making him cater to the popular fancy. If he is the right man in the right place, it is absurd to limit him to a fixed term, for his position is not a reward. The county is purchasing his services and is supposed to get value received, and it should continue to purchase so long as he delivers the goods.

The eighth proposition, that no road is wholly permanent and that it requires continuous upkeep, is intended to impress upon legislators and administrative officials the necessity for making adequate financial provision to care for roads, no matter how costly or efficient their construction.

The ninth proposition, that cash is a much more satisfactory form of tax than labor, is put forward as a protest against continued cherishing of that old heirloom known as "statute labor." If you provide an efficient highway engineer or county superintendent with a modest amount of cash and let him select competent, efficient laborers, he can quadruple the effective results obtained by the same number of laborers under the old statute system.

The practical application of the tenth proposition would mean the employment of convicts in road-building, the preparation of road materials, or in other works of public improvement so far as practicable. This proposition is intended also to emphasize the necessity for correlation of the States' various agencies in the interest of road improvement. For example, a State geologist should be helpful in the selection and location of road materials, the laboratories of State universities should be useful in the testing of materials, the university staff should be helpful in the giving of theoretical instruction and in many cases in practical extension work, State bureaus of statistics and agriculture should be helpful in accumulating essential data for the road improvement work in the State, and State civil service commissions should be of very great use in the inauguration and conduct of the merit system in the filling of positions requiring technical or practical qualifications and experience.

System in Road Management

By CHARLES J. BENNETT

Highway Commissioner of Connecticut

THERE are certain principles to be applied to organizing or systematizing a highway department which can be applied generally wherever one is to be formed. Further than that we cannot go. The particular methods of accounting, the minutiæ, the forms, types of books and methods of reporting and recording reports are in every instance a peculiar problem to be solved locally.

In the first place, it is necessary to realize that there are two results to be secured, the proper and economical spending of a certain amount of money in the way best fitted to serve the general public, and the presentation of the method of spending this money to the public, so that it may be thoroughly informed as to how its money has been apportioned and what results have been reached.

The first requisite in organizing a department is a system of bookkeeping showing at all times the condition of the accounts, and keeping a check on the expenditures made for specific purposes. Orders for the work to be done should be immediately compiled and entered in the books so that the disbursements may be kept up to date. There should be no possibility of verbal orders which would call for expenditures without an accompanying written report and order, which should be entered at once in the ledger. This system of accounts should provide also for a periodic statement of the financial condition of the department, which statement or balance should show not only the cash available, but also the actual amount available after all the liabilities, bills and debts of the department were paid.

MILITARY ORGANIZATION

A highway department should be organized on the military system. It should be subdivided so that each part might have certain duties, with a definite amount of money to spend. Each subdivision should report directly to the superior officer and through him to the head. The organization should be such that no orders should be passed around a subordinate. It is quite necessary in dealing with a force of any magnitude that the rank and file should know the purpose of the organization and the wishes of the chief. In other words, the department should be imbued with the spirit and aims of the man at the head, for in this way each man will work, as far as is possible, along the same lines, and the results gained will be more nearly uniform and standard.

An effort should be made to build up

patriotism in the department, which should work for the betterment of the road system rather than for the personal benefit of the employees or of the political party which is responsible for the appointment of members of the department. A modified civil-service system is a good thing, in that it makes the men more sure of their positions than under a political system. Such a civil service should, however, provide for the removal of employees by the head of the department without applying to any outside body, such as a State or municipal civil service commission. The whole idea of such a department and the organization of the force should be to secure the right men for the right places and keep them there while they give good service. There is nothing which can disorganize a department so much as the right of an employee to apply to some outside body which has no knowledge of conditions and which can only judge of a man's ability or his right to hold a position by an examination on his technical knowledge or by a brief hearing.

ORGANIZATION CHART

In the organization of a force a chart should be prepared showing the connection between employees, the person to whom an employee should report, and what the duties of each are. The best results are to be gained by delegating authority to a man and placing confidence in him, having in mind the theory that men are by nature honest and will endeavor to do right and gain good results if given the opportunity. Allowance should be made for honest mistakes and a careful record kept of such mistakes so that a man may realize if removed that the reasons for his removal are sound and based on results showing his lack of ability.

A method of reporting work should be established and kept, giving plainly and simply all the necessary information as to the actual physical operations carried on by the employees. The local situation will govern the extent and frequency of such reports, but they should show primarily the work which the employee is trying to do, the probable cost and, from time to time, the actual cost, as well as remarks as to the success or failure of any particular experiment. There should not be an endeavor to make complicated reports which should show minutiæ to the point of the ludicrous, for a system of reporting which becomes so complicated that it is not simple of understanding fails utterly in its purpose.

UNDERSTANDABLE REPORTS

Reports in connection with the accounting system should be so made that the outsider, layman or professional, may secure information as to the comparative costs of certain classes of work, the success or failure of certain types of roads and the financial value of expenditures for certain specific purposes. For instance, it might be possible to demonstrate by a system of records that a larger first cost of construction would be very much more economical eventually than a small first cost with a corresponding large charge for maintenance in future years.

A road department has the duty of presenting its operations to the public eye, not only as results on the roads themselves, but in the success or failure of the department as a financial proposition. This presentation must be made in the form of a periodical report to some superior body, as the mayor of a city or the legislature of a State. In perusing many reports the writer has found that there is an entire lack of system in presenting the information and no effort is made to make reports clear. The spirit most shown is to claim general excellence for the department and try to justify its continuance. Certainly there are some failures made by road builders, which should be reported for the good of the work. Reasons for failure should be stated, whether the failures be financial or physical.

It is quite possible and necessary to make an annual report which is readable and interesting to the layman. The text portion of such a report should be written in plain English without technical terms and with general results stated broadly and succinctly. Tabulation of records should be made as simply as possible and the cost per unit should not only give definite figures but state just what details were included in the units of work done.

The simpler the method of bookkeeping, organization, reporting and recording, the more successful will be the results in spending the money economically and the more successful will be the opportunity of the official at the head to present his information so that it will be of benefit first, to the general public, and, second, to the profession of which he is a member.

Simplified System of Town Highway Accounts

By FRED BUCK

Assistant Deputy Commissioner, New York State Highway Department

THE system of town highway accounts which went into effect Jan. 1, 1909, as a part of the present highway law of New York State has proved very satisfactory, and excellent results have been obtained under it. The funds for town highway work in New York State are derived from two sources: First, a tax levied by local officials upon the several towns, and second, supplementary moneys paid by the State to the towns for the same purpose. The amount of State aid payable to each town is dependent upon the assessed valuation per mile of highways of the town and the amount raised by the town as the highway tax in each year. These moneys combined form what is known as the highway fund.

In the prosecution of the work the town superintendent of highways is the man in charge. He hires the men and teams, purchases materials, directs the work and acts as paymaster. The paying, however, is done by means of vouchers issued by himself as town superintendent, the vouchers being redeemed in cash by the supervisor (who is the chief fiscal officer of the town) and retained by him as a receipt for money paid until the close of the fiscal year. Then, upon rendition of his annual report and its acceptance by the town board, these vouchers are filed with the town clerk and become a part of the permanent records of the town.

PAYMENT VOUCHERS

These vouchers, which are furnished to all towns by the State Highway Department, consist of a printed form with the necessary blank space for the insertion of the date, the name of the payee, the dates on which service was rendered, the number of hours of service or quantity of material, as the case may be, and the road for which it was furnished. Each voucher is attached to a stub upon which are blank spaces similar to that of the voucher.

The supervisor is provided with a supervisor's account book, printed and ruled to receive an entry of each voucher paid, spaces being provided for data relative to the voucher corresponding to that in the body of the voucher itself. Pages are provided at regular intervals for a recapitulated statement of vouchers paid, the data upon these recapitulated pages being finally carried forward to a single page thereon condensed into a form of statement, which is the annual report of receipts and disbursements required of each town supervisor under the highway law. Blank forms are provided for such additional copies of this report as are required to be furnished to the county superintendent of highways, the State highway commission and the State comptroller. No other books or accounts are necessary for the town superintendent of highways or the supervisor in properly receiving, disbursing and accounting for the highway moneys of any town which have just been described.

Partial audits of the highway accounts of any town are made by a representative of the State highway department at any time during the year when for any reason it shall be deemed that the same is necessary or expedient. By doing this many errors are prevented which might otherwise occur and unwise or extravagant expenditures are prevented, or checked if begun.

Each year a complete audit of the highway accounts of each town in the State is also made, and it is found that the form of voucher and manner of accounting for the same provided for the supervisor greatly simplify and facilitate the work of the auditor.

Heavy Traffic Roads

By HENRY G. SHIRLEY

Chief Engineer, State Roads Commission of Maryland

IN no other line of engineering should a larger factor of safety be used than in estimating the amount, intensity and kind of self-propelled traffic that will pass over our improved roads in the near future. The writer has made studies of roads where the traffic before improvement consisted of light vehicles and nothing heavier than two-horse loads; as soon as the road was reconstructed, however, the amount of traffic increased from 50 to 300 per cent, and the loads from 2 tons to 10 or 12-ton motor trucks and 14 or 18-ton tractors. He also recalls constructing a section of road through a very sparsely settled section. Estimating that it would be long before it would be more thickly populated, he selected for the surfacing a soft local limestone which had sufficient strength and hardness to carry the existing traffic. Scarcely had the road been completed when several large tracts of woodland were cut and the lumber was transported over the road to the railroad on wagons drawn by large traction engines with cleats. The effect of this heavy traffic on the soft limestone surface can be easily surmised.

Drainage of a roadbed that is required to carry heavy traffic should be well taken care of by subsurface drains. Width of roadway and width and thickness of the metal surfacing should be designed to meet the requirements of the present as well as the future traffic, but the minimum over-all width should be 30 ft. and the metal surfacing 18 ft. Broken stone or gravel make a fair foundation, but concrete is almost as cheap and is preferable.

The thickness of macadam and gravel should be not less than 5 nor more than 10 in. after rolling, while concrete should not be less than 4 or more than 8 in., depending primarily upon the character of the soil of the sub-base and the intensity and character of the traffic it will have to sustain. In some cases where the loads are few but very heavy it has been found economical to lay a strip of high-class pavement in the middle of the road for a width of from 9 to 14 ft., with a cheaper and less durable material on each side.

TRAFFIC TO GOVERN TYPE OF PAVEMENT

Before selecting the type of pavement to be used, an accurate census of the different kinds of traffic should be taken and a very thorough study made of the surrounding section, as well as an estimate as to the possible increase of the different kinds of traffic, or the decrease of one kind and the large increase of another. Roads in the outlying districts, where horse-drawn traffic comprises the larger percentage, should be constructed of macadam with a light surface treatment. Concrete will also be found serviceable and desirable. Where motor units are in the majority, bituminous macadam or concrete will give good results. Near the centers of population, where the traffic is mixed and heavy, concrete, bituminous concrete, asphalt or vitrified brick will prove economical. Where the heavy traffic is concentrated, brick, asphalt or stone block are the most suitable.

There can be given no set rule for selecting the type of construction that should be used on a given section of road to carry a known traffic. The following method of selecting a surfacing to carry an estimated traffic, however, will prove fairly accurate where a study can be made and the maintenance cost can be had of roads constructed and maintained under similar conditions. Where the annual cost of maintenance of a surfacing will exceed the annual cost of maintenance of a more durable type by 4 per cent of the excess cost of the latter, the more durable type should be used—and vice versa.

A great need exists for adequate laws to regulate heavy loads on improved surfaces. The manufacturers of tractors, motor trucks and other hauling engines have devoted the greater amount of their energies to developing a machine that will haul the largest load in the shortest period of time, using the least amount of fuel. It is their duty and will finally be to their interest to devote quite as much energy and brains to constructing their engines and motor trucks in such a way that the least amount of damage will be done to the surfacing in passing over the roads. It is most important that the manufacturers of hauling equipment and highway engines should work together in framing a set of adequate laws controlling the use of hauling equipment over improved roads, as well as in developing wheels which will cause the road surfacing the least amount of damage. By co-operation large sums can be annually saved on maintenance, greatly benefiting all concerned.

Maintenance of Earth Roads

By GEORGE W. COOLEY
State Highway Engineer of Minnesota

IN some of our western States there has been suggested a plan requiring contractors on surfaced roads to provide maintenance as soon as a section is completed, continuing for at least thirty days after the work is accepted. Thus the engineering department has time to provide for the organization of a maintenance crew without overlapping or interfering with the work of construction. In Minnesota the continued use of a drag or planer on grade building is required. The latter method has been found very efficient; it renders future work on the surface less expensive and tends to produce a more compact roadbed.

The tool found most satisfactory in this work is the "Minnesota road planer," which consists of the two blades of an ordinary road drag fixed between a pair of runners about 14 ft. long. The blades are fixed at an angle of about 60 deg. to the runner and made either rigid or adjustable. The planer is hauled on a line parallel with the axis of the road and operated like the ordinary drag. The old-style drag without runners has a tendency, especially on new work, to increase the undulations frequently occurring on road construction, while the planer eliminates these faults.

In the construction of a new earth road made in an open level or rolling country the use of an elevating grader is quite common. Under suitable conditions its use is justified by economy in construction work, but its value is lessened if sods are cast into the roadbed, depending on the regular traffic to consolidate the mass so built up. This can be avoided by the use of a tractor in hauling the grader, which thoroughly pulverizes and packs the materials.

THREE SYSTEMS OF MAINTENANCE

Under the present road laws Minnesota has made adequate provision for the care of all roads. Township and county roads constitute approximately 90 per cent of the road mileage of the State, and of these about 90 per cent are earth. To care for the town and county roads a 1-mill tax is levied on all property in the town creating the town dragging fund. This is expended for dragging all except State roads under the direction of an overseer appointed by the town board. This appears to be the most satisfactory method of caring for the earth roads under control of the local authorities, but there should be provision for general supervision of the work by the county highway engineer.

For the care of State roads 20 per cent of the State road funds, with a due proportion of county funds, are set aside and may not be used for any other purpose than maintenance of State roads. As the State roads include all types of construction, different systems of maintenance have been required in the different localities. In general, three systems have been established—the patrol system on macadam and well-built gravel roads, and the maintenance-section system and road-drag system on other roads, all being under the direct supervision of the district highway engineer.

Under the patrol system one man is assigned a section of from 5 to 7 mi. and works with hand tools. It has been found necessary to supplement this work with the occasional use of a team. Under the maintenance section system one man is given charge of from 20 to 30 mi. and is employed continuously with his team on the care of his section. He is given authority to employ additional help, and usually has two teams and four or five men at work. Contracts are also entered into by the section foreman with residents along the road for dragging after each rain or when ordered to do so by him. The section crew takes care of all minor items of construction, such as placing culverts, and we have found that the work when properly done is really of a constructive nature. The section system is without doubt the most effective, and is being adopted generally throughout the State.

The dragging system requires the employment of a superintendent of maintenance, for convenience one of the engineer's assistants, whose duty is to contract or make arrangements for the dragging of all roads under his charge and to see that the work is done at proper times. This system is suitable for slightly undulating prairie country, where most of the roads are of earth. To get best results the superintendent should have at his disposal light graders to reshape the roadbed at least at the beginning of each season. On earth or gravel roads no maintenance system is complete which does not contemplate the use of planers or similar devices, and a combination of work as outlined under the section system is recommended.

Drainage Structures

By W. E. ATKINSON
State Highway Engineer of Louisiana

ALL drainage structures under the Louisiana highway commission's control are computed to carry safely a minimum live load of not less than ten tons, plus 50 per cent impact and a factor of safety of four. It has been the policy of the commission to construct, wherever funds and conditions will permit, permanent structures and adopt uniform and standard plans for bridges and culverts for any particular highway project.

Due to the alluvial character of the soil, with the exception of some sections in the northern part of the State, there are instances where it is not safe or economical to construct the arch type of concrete bridge. Even with some of our girder and slab bridges it often becomes necessary to provide pile foundations for the piers, abutments and wing-walls. In some places it is necessary that these piles be of concrete instead of wood.

We have found it advantageous and economical to provide, where conditions will permit, a uniform design for all drainage structures, especially for those of concrete construction, that the contractor may use the same drainage forms over and over, permitting thereby much lower bids per cubic yard on such work than under a system of non-uniform standard designs. In addition to concrete bridges, the department is building many wooden bridges, both of creosoted and uncreosoted materials, this character of construction predominating in some parishes due to lack of funds for more permanent construction.

TYPES OF CULVERT

The department has installed several types of culverts—vitrified clay, cement, concrete, cast iron, wood, corrugated galvanized iron, etc. The type of construction is governed by the available funds and topographical features, together with character of soil encountered in foundation. Where practicable, concrete has always been recommended.

At many places, however, we have found it impracticable and not economical to use concrete culverts and others of a monolithic character, especially in some of the bayous and coulees. In one place in particular where the foundation in one bayou was poor a strip 2 x 2 in. x 16 ft. was pushed down its full length in the bottom of the bayou. This bayou was 250 ft. wide across the top and 25 ft. deep, and the only opening necessary was that of an equalizer with an area of some 28 sq. ft. to be filled over with earth, thereby making a bridge of earth and of an equalizer. The equalizer installed at this particular location was a ten-gage 6-ft. diameter corrugated galvanized iron pipe culvert. The entire cost of this combination bridge, if it may be so termed, amounted to $2,059.27, including an item of $215.73 for riprap, whereas to have bridged the bayou with concrete, or to have attempted to build a concrete culvert, would have made the cost very much in excess of this amount.

Due to débris, drift wood and other extraneous matter, our highway department has adopted a policy not to install any culverts less than 18 in. in diameter. A diameter of 24 in. is preferred.

Engineering Supervision of Road Construction

By W. S. KELLER

State Highway Engineer of Alabama

IT is not uncommon for commissioners without technical training to save their counties the salary of an engineer and spend it thrice over in useless work and expensive maintenance. Despite the fact that a majority of commissioners or supervisors have had no training whatever in road building they will concede to no one that they are not as well qualified to direct road work as any engineer they can employ. They will often admit that an engineer should locate and stake off a road, but they think his duty ends there. It is just as necessary that an engineer supervise construction work as it is that he should locate the road. The commissioners of a certain county in Alabama claimed that they were building roads as cheap as or cheaper than any contractor could do the work. They had an engineer estimate the cubic yardage of earth moved for a certain period and to their surprise it was costing 37½ cents per cubic yard, when the average contract price in Alabama for three years had been 23 cents per cubic yard.

The remedy for these ills is to have some one in charge of road building who is qualified by education and training, who is free from political influences, and who can be held responsible for results. Very few counties have commissioners or supervisors who devote all of their time and attention to their office and it is self-evident that an engineer trained in road building will get better results than can any set of men who give only a few days in the year to their public office.

It is almost impossible to convince many county officials that an engineer can easily save his salary several times over by making certain changes in location and grade and by economically administering the affairs of the county. As a general rule a county gets more in return for money spent for engineering services than for any other single item connected with road construction. A good engineer is a dividend producer for a county. In speaking on this subject at the American Road Congress in Atlantic City in 1912, Col. W. D. Sohier said: "You will find if you look at any private corporation that the ordinary engineering expenses for any work of the character of road building, any constructional work, is usually about 10 per cent, and that it is good money well spent."

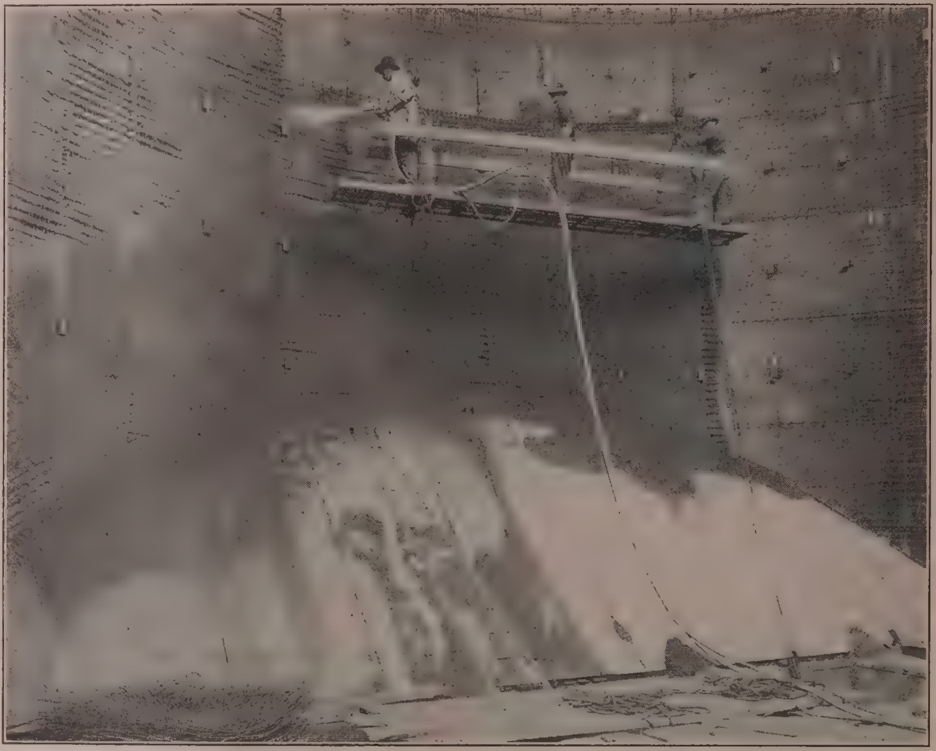
From the rules and regulations of the State highway department of Alabama, the following is taken: "The functions of the commission are judicial and those of the engineer, executive. The engineer will receive and carry out the directions of the commission and shall, in turn, direct those under him. The engineer shall have full charge of construction work, directing it in all its details. Any orders the commission wish to give an employee shall be given through the engineer, and the engineer shall have the right to employ, with the consent of the commission, and to suspend, subject to discharge, without consulting the commission. All suspensions shall be reported to the commission for such action as they may deem necessary."

GOOD STORAGE SITES are available in the Snake River basin, Idaho, but only a few have been utilized so far, according to Water-Supply Paper 347 of the U. S. Geological Survey. About 400,000 acre-feet of water can be stored in Jackson Lake by a dam which has been constructed by the Reclamation Service. The largest site is at Swan Valley, on Snake River, where the water available for storage is approximately 4,000,000 acre-feet. Irrigation has reached a high stage of development in the Snake River valley, yet approximately 6,000,000 acre-feet of water annually runs to waste. The streams afford enormous water powers, but only a few sites have been developed.

Lining Large Steel Coal Tank with Concrete

Cement Gun Is Used to Shoot a 5-in. Surface Intended to Prevent Abrasion and Corrosive Action of Coal

AS a preventative against the corrosive action of the sulphur in coal and against abrasion the Minnesota Steel Company has lined a large circular steel coal tank at Duluth with concrete. The tank, which is approximately 55 ft. in diameter and 40 ft. high, with a capacity of 2100 tons of coal, is used in supplying coal to the steel company's coke plant. For furnishing coal for the gas producers of the open-hearth furnaces, thirty-three parabolic bunkers approximately 20 ft. wide, 12 ft. deep and 17 ft. long are provided. The coke oven bins were lined with 5 in. of concrete and the producer bins with a 2-in, concrete lining. The cement gun was used for this purpose.



USING CEMENT GUN TO LINE LARGE COAL TANK WITH CONCRETE

Iron lugs were provided at numerous places around the inside of the tank. To these vertical rods were securely wired in horizontal bands. The wire mesh was held away from the steel by a distance of ¾ in. Gunite was then applied. The first layer was shot through the mesh; it served to hold the wire cloth in place and covered and protected the steel plate. The second layer, bringing the coating to a total thickness of 5 in., was then applied.

MATERIAL FOR LINING

The gunite material applied consisted of a 1:3 mix of Portland cement and torpedo sand mixed dry. It was shot through the hose by the gun with an air pressure of from 40 to 60 lb. Immediately before emerging from the nozzle the dry mixture was hydrated, the water coming through a separate and smaller hose which can be seen in the photograph. The quantity of water was under the control of the operator.

The thickness of the coating applied in the tank was made 5 in. on account of the very large size of the tank and the severe duty to which it would be subjected. In the case of the parabolic bins, which are much smaller and where the drop of the coal against the bottom and sides could never be very great, the lining was reduced to 2 in.

The work was executed by the Cement-Gun Construction Company, of Chicago.

Illinois Central Track Depression at Mattoon

Work in Progress Involving Elimination of Grade Crossings and Also Erection of Several New Structures

TRACK depression being carried on by the Illinois Central Railroad at Mattoon, Ill., involves the elimination of street crossings at grade, the separation of the Illinois Central and Big Four grades, new freight track facilities, a new freight house and a passenger station which will be used jointly by the Illinois Central and the Big Four. When the work is completed all but one grade crossing on the Illinois Central, and that of a minor character at the south end of town, will be removed.

ANOTHER VIEW OF CUT, WITH TRAFFIC MAINTAINED ON HIGH-LEVEL TRACK

EXCAVATION

The total cut approximates 450,000 cu. yd. and is mostly through yellow and blue clay. All excavation is being wasted where it can be used in future grade reduction. The average haul has ranged from 4 to 6 mi. About 90 per cent of the earth removal has been completed. The average monthly excavation, which is being done by two 70-ton Bucyrus steam shovels, working from each end toward the center, is about 40,000 cu. yd. per shovel. The entire depression is being made with a 1:1 slope, there being enough right of way—an average of 200 ft.—to make retaining walls unnecessary. In order to have two main tracks clear for traffic at all times, half of the cut was brought to final grade before the other half was touched. When the first half was completed, two tracks were laid on the lower level and traffic was diverted thereto. The tracks in use on the uncompleted half were then removed and work was started on its excavation.

Reinforced-concrete bridges are to be constructed at DeWitt, Champaign, Richmond and Charleston Avenues and Broadway. The Broadway bridge, which is located on the principal street of the town, will be the largest of the five. It is to be 100 ft. wide, with a 50-ft. driveway in the center and 25-ft. sidewalks on each side.

BIG FOUR BRIDGE

A double-track steel and reinforced-concrete bridge about 200 ft. long, the design for which has not been prepared as yet, will be used to carry the Big Four over the Illinois Central between Broadway and Richmond Street. The Big Four is now being carried over on a temporary pile trestle.

Several important industrial plants that could not be removed from the right of way are supported over the slope of the cut by concrete walls. As the new profile brings the tracks about 25 ft. below these industries, spur tracks were laid on the other side of the buildings and run on an incline to the main line.

The grade reduction required the removal of the former freight house with its trackage facilities. Additional property was acquired in a new location just south of the business section of town. A modern brick freight house 32 x 200 ft., together with driveways, team tracks and coach storage tracks, all connecting into the Indiana division tracks, have been constructed. To eliminate a crossing between the main line and the Indiana division four Y-connections had to be put in.

PERSONNEL

The grading is being done by contract which was awarded to J. D. Lynch, of Monmouth, Ill. Lorimer & Gallagher, of Chicago, are subcontractors on the south end. Actual work was started April 1 and is now 90 per cent completed. This includes excavation, grading and track work. W. G. Nusz is the assistant engineer in charge of the work in the field, reporting to F. L. Thompson, assistant chief engineer.

CUT AND TEMPORARY BRIDGE, LOOKING SOUTH FROM BIG FOUR CROSSING

Brick Highways in King County Washington

BRICK highways are being used extensively in King County, Washington, and are considered economical, because good No. 1 paving blocks can be bought there for $29.25, and No. 2 pavers for $22.50 per thousand. When laid on a 5-in. concrete base and well grouted with a 1:1 cement mix, practically no maintenance has been required on the oldest brick-paved roads in service.

Concrete pavements are not considered to any extent in this county at present, but since Jan. 1, 1914, there have been completed outside the city of Seattle 7 mi. of brick pavement of 18 and 20-ft. widths. These pavements were all laid on a 5-in. base of 1:3:6 concrete and grouted with cement. Including a moderate amount of grading in most cases, the average cost per mile of these completed roadways was $29,800.

Where this type of construction is found too expensive, dirt roads with a graveled wearing surface are built. At the present time the county has under way some 95 mi. of the latter type of construction, to cost a total of about $625,000.

Large Trussed Concrete Bridge

Structure of 182-Foot Span, with Parabolic Reinforced-Concrete Compression Chord, Believed to Be Longest of Its Kind

A REINFORCED - CONCRETE bowstring bridge of 162-ft. span, designed for a live load of 80 lb. per square foot and a wind pressure of 30 lb. per square foot, has been built at La Louviere, Belgium. The clear width between trusses is 9 ft. 3 in., the structure being used solely by pedestrians. It is believed to be the longest of its kind. The design is shown in the accompanying drawing. The top chord is a parabola and has a uniform cross-section of 12 x 18 in. The bottom chord is suspended by 12 x 16-in. verticals and serves as a tension member to resist the horizontal component of the end reactions. Nine 16 x 18-in. struts located at panel points provide overhead bracing to stiffen the compression chords.

FLOOR

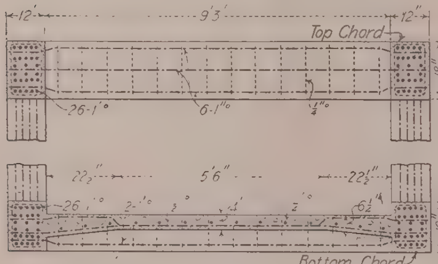
The floor is figured as a slab spanning the distance between trusses. It is 4 in. thick at the center, the thickness at points of support being increased to 6¼ in. in order to take care of the increase in vertical shear. Because of the heavy reaction of 65 tons, the bearings at the ends of the trusses have been designed in the same way as for a steel bridge. The upper parts of the roller bearings are fastened to the truss by three horizontal bolts, inclosed in pipes so that they can be easily removed.

The permissible unit stresses in steel and concrete were selected in accordance with the rules for Belgian highway bridges, and amounted to 710 lb. per square inch for concrete in compression and 17,070 lb. per square inch for steel.

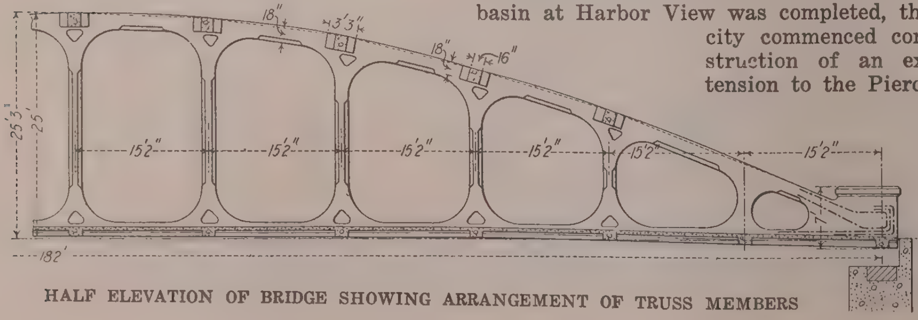
CAMBER TO TAKE CARE OF DEFLECTIONS

A 3-in. camber was provided to take care of deflections. The maximum permissible deflection for a full live load of 80 lb. per square foot was 2.2 in., but under the test load the actual deflection at the center was only 0.47 in. In accordance with the wish of the designer impact tests were also made. Twenty-four workmen marched over the bridge in both directions and afterward assembled at the center of the bridge and jumped five to six times. Under the first test a wave action was created which at no point exceeded 0.12; under the jumping-test this wave action increased to 0.20 in.

The bridge was designed by Professor Vierendeel, of Bruges, and the work was executed by Grondel Brothers, of Ghent, Belgium.



CROSS-SECTION OF TRUSSED BRIDGE



HALF ELEVATION OF BRIDGE SHOWING ARRANGEMENT OF TRUSS MEMBERS

Sewerage System for Panama-Pacific Exposition Grounds at San Francisco

Temporary Nature of Structures Makes Design Different from Standards Usually Followed—Wood-Stave Pipe Was Used Extensively—Part I

By WILLIAM CLYDE WILLARD
Assistant Engineer, Panama-Pacific International Exposition

LEVEL ground lying at an elevation of only from 3 to 6 ft. above high tide, settling of the material placed by hydraulic methods to fill in a tidal basin and marsh, and the decision to have but one sanitary outfall sewer for the entire 600-acre tract, offered serious obstacles to the design and construction of the sewer system for the Panama-Pacific International Exposition in San Francisco.

In all work of the exposition the San Francisco city datum plane was taken as zero for elevations. The datum is 11.768 ft. above mean low water, the datum of the U. S. Coast and Geodetic Survey, the U. S. Army engineers and the California State harbor commission. Much of the ground was below city datum, so it was necessary in almost all work to deal with positive and negative elevations.

From data collected at the Presidio, covering the time interval 1897-1907, the elevations of different tide stages, below city datum, were as follows:

ELEVATIONS OF TIDE STAGES BELOW CITY DATUM

Lowest tide observed	14.4
U. S. C. & G. S. zero	11.8
Mean of all low waters	10.6
Mean sea level (U. S. G. S. zero)	8.7
Mean of all high waters	6.6
Highest tide observed	3.6

At the time the site was taken over three city outfall sewers existed in the Harbor View section of the exposition grounds. These paralleled each other running from south to north. The easterly one, a 6-ft. circular sewer in Laguna Street, emptied into a small cove of the bay; the second one was in Pierce Street, about 2500 ft. further west, and discharged through a 6-ft. circular section into the tidal basin; the third one, having a 5-ft. circular section, was in Baker Street, 1900 ft. still further west, and discharged directly into the bay. Besides these trunk sewers there were over 15,000 ft. of branches ranging in size from an 8-in. vitrified pipe to a 2-ft. 6-in. x 3 ft. 9-in. brick, egg-shaped section. All these carried both sewage and storm water.

Immediately after the filling of the tidal basin at Harbor View was completed, the city commenced construction of an extension to the Pierce Street sewer from its former end 1773.75 ft. north across the fill to the bay, making a submerged two-compartment outlet having a flow line elevation of —23.0 ft. at the outfall. This sewer is of concrete, circular in section and increases in diameter from 7 to 7 ft. 6 in. and then to 8 ft.

The city next constructed two intercepting sewers, one west from the Laguna Street sewer to the Pierce Street sewer and the other east from the Baker Street sewer to the Pierce Street sewer. The intercepting sewers were designed to carry only the dry weather flow of the two trunk sewers, together with such sewage as they picked up along their run. The sewage was deflected from each trunk into its intercepting sewer by a weir placed just below the point of junction. The storm water flow, carrying the diluted sewage, passes over the weir and on down the respective trunk sewer to the bay.

The construction of the two intercepting sewers leading into the Pierce Street sewer was the result of an understanding between the exposition company and the city to make the Pierce Street sewer the outfall for the dry weather flow of the entire exposition site, and the adjacent sections of the city. The reason for this was that the Pierce Street outfall is advantageously situated with respect to tidal currents. With numerous sanitary sewage outfalls foul conditions would have developed along the waterfront. Therefore, in designing the sewer system for the exposition site, where any sanitary sewage had to be cared for, the city sewers were used as the backbone of the system. A great amount of storm water was also emptied into them, but where their capacity was insufficient, the storm water was kept separate and carried directly to the bay by separate storm sewer outfalls.

GENERAL ASSUMPTIONS

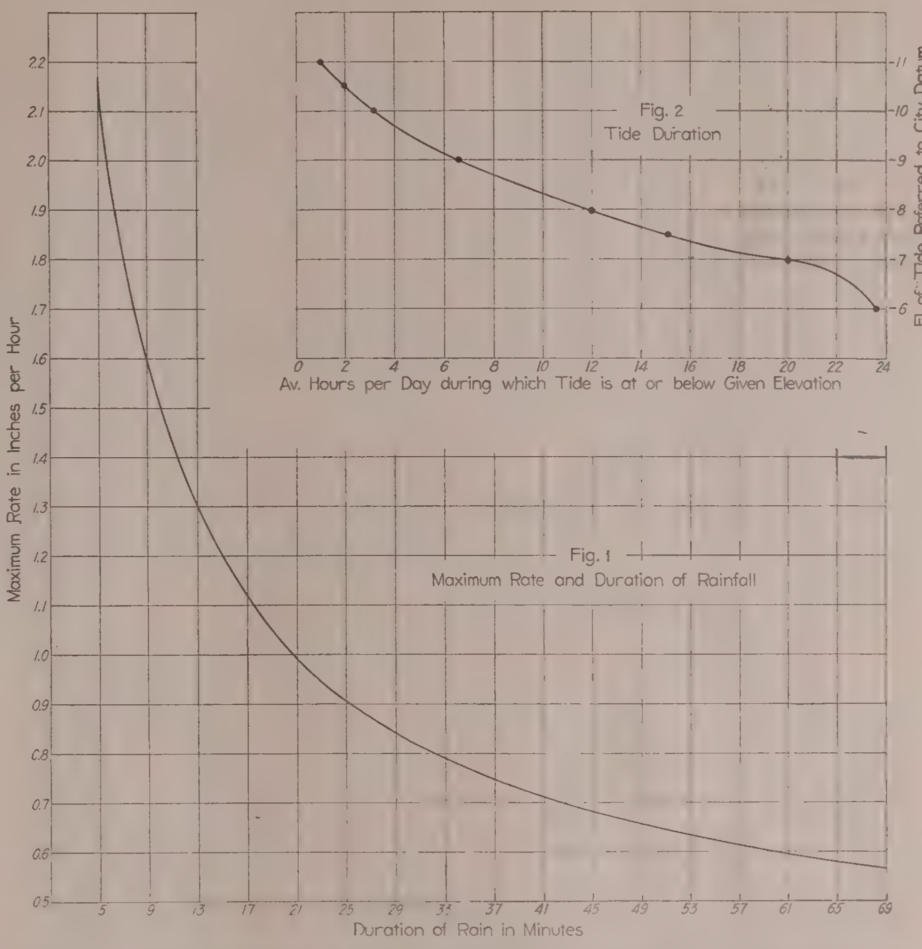
In computing the sewer sizes the rainfall rate table prepared several years ago by the San Francisco City Engineer's office and still used by them, was used. The

TABLE 1—RUNOFF OF VARIOUS EXPOSITION DISTRICTS

District	Runoff Per cent of rainfall	Interval of rain giving maximum runoff, minutes
Amusement concessions	70	5
Areas covered by exhibit palaces	100	5
Paved areas of courts, roadways, entrances, etc.	100	5
All gardens	25	5 to 10
Area for State and foreign pavilions	40	5 to 15
Stock exhibit district	70	5 to 9
Drill ground and athletic field	30	5 to 13
Steep hillside above drill ground	40	10
Race track	60	5 to 10

curve in Fig. 1 was plotted from this table. The runoff for the various districts is given in Table 1.

From an investigation of the United States tide tables for San Francisco Bay, the curve in Fig. 2 was plotted. This gives the average normal time in hours per day at which the tide is at or below certain elevations. Since much of the exposition site is on low ground, in some places the finished surfaces of roadways and gardens being but a few inches above the top of the large city sewers, it was impossible to design a system which would not be subject to hindered or impaired operation at the highest tide during a heavy rain. The use of pumps to relieve this condition would have largely increased construction costs, and many times increased operating costs. The city engineer's office, in designing the Pierce Street sewer extension, computed a hydraulic grade line elevation of —2.00 ft. at a point 200 ft. from the outfall, which will only be obtained when the tributary area of the city is built up; the conditions imposed by the presence of the exposition, however, undoubtedly more than equal this. The finished surface of the exposition at the point above mentioned on the Pierce Street sewer roadways and gardens is —1.5 ft.



FIGS. 1 AND 2—MAXIMUM RATE AND DURATION OF RAINFALL AND TIDE DURATION

TIDE LEVEL AND RAINFALL

In the general design it was, therefore, necessary to assume that the possibility of simultaneous occurrence of extreme high tide and heavy rainfall was exceedingly small, and in any case could only prevail for a very short period during which the temporary flood condition resulting would not damage or inconvenience the exposition to any extent, as gardens and roadways only would be affected, the building floors being all set well above the zone of danger.

From a study of the elevations and durations of tide level in Fig. 2 a height of —7.0 ft. (approximately 0.4 ft. below the Presidio record of the mean of all high waters) was taken as the point from which to start the hydraulic grade line for obtaining the required sewer sizes, where the sewer in question emptied directly into the bay. In case the sewer emptied into one of the city trunk sewers, the inside top of the city sewer was taken as the point from which to start the hydraulic grade line of the joining sewer. In the case of the two intercepting city sewers, the inside top of these sewers at their junction with the Pierce Street trunk, was taken as a point on the hydraulic grade line and their capacities computed back therefrom.

Besides receiving a small quantity of sewage from the Baker and Laguna Street sewers, the two interceptors will be required to carry the roof water and sanitary sewage from the agriculture, mines and machinery palaces, and the dry weather, or sanitary, flow from one half the Liberal Arts, the Education and Social Economy, Horticulture and Food Products palaces. The flow from the exhibit palaces taxes the capacity of the Baker and the Laguna Street sewers, and in the Court of the Four Seasons it was necessary to include a separate storm system emptying into the Yacht Harbor.

RUNOFF FROM ROOFS

The runoff from the roofs of all exhibit palaces was computed for a 5-min. interval and 100 per cent runoff. The mouths of downspouts were flared enough to theoretically take the capacity of the vertical pipe. One square inch of cross-section of downspout was provided for each 500 sq. ft. of roof surface, but no downspout less than 4 in. in diameter was used in any exhibit palace except for the fine arts and horticulture, where as small as 2 in. was used.

In designing the structures for the exposition sewer system the problem to be solved was entirely different from that for any municipal sewer system. First, all parts of the system, with but a few exceptions described later, were to be temporary, their usefulness expiring with the close of the exposition in December, 1915. To provide a more permanent system would add unnecessarily to the initial cost. Besides, much of the land leased by the exposition company was leased with the agreement that at the close of the exposition the company should restore the ground to its original condition. Therefore, the more temporary the sewer structures, the more easily can they be removed later. Second, the cheapest material to meet the above conditions had to be selected. Third, where the sewage is pumped, and also for some combined sewers, the pipes had to be laid in sand at a depth ranging from zero to 10 ft. below the normal elevation of the ground water, so that the material used, though temporary and cheap, must be as watertight as it would be possible to make any permanent sewer.

SIZES AND TYPES OF PIPE SEWERS

After considering these requirements, second quality vitrified ironstone pipe, both dipped and undipped machine banded fir wood-stave pipe, continuous-stave redwood pipe and timber box culverts were used to fit conditions in different sections of the site. From an investigation of all available records it was found, before determining upon the use of wood-stave pipe, that such pipe had been used in a few places to a very limited extent for sewer purposes. The total length of wood-stave pipe sewers built by the exposition is approximately 21,720 lin. ft., or over 4 mi. This, undoubtedly, establishes a new record in this line of construction for wood-stave pipe. The sizes used ranged from 10 in. to 51 in. in diameter.

The required size of the ironstone pipe sewers was obtained from the Williams and Hazen tables for tile sewers. The size of the wood-stave pipe was obtained from a diagram published by Theron H. Noble based on the formula,

$$Q = 1.28\, D^{2.67}\, H^{0.555}$$

where Q = discharge in cubic feet per second; D = internal diameter in feet; H = head in feet in 1000 ft.

In all cases, with a few exceptions under some of the exhibit palaces, in the State and foreign pavilions district and the stock exhibit district, both the ironstone and wood-stave pipes were laid on the following minimum grades:

TABLE 2—MINIMUM GRADES FOR PIPE SEWERS

Size of pipe, inches	Min. per cent of grade
6	1.0
8	0.7
10	0.5
12	0.4
15	0.3
21	0.2
24	0.1

The exceptions to this practice occurred at the upper ends of a few sewers where, by placing the small pipes on slightly flatter grades than those in Table 2, the cost of the system could be considerably reduced by reducing the depth necessary for the lower sections.

(To be concluded.)

Simple Method of Concrete Slab and Beam Design

Table of Values Determined by Permissible Unit Stresses for Use with Moment in Formulæ for Depth and Reinforcement

By JOHN W. GILLIES, C. E.
Engineer, Charles W. Leavitt, Jr., New York City

WHILE there are many tables for the design of concrete steel members under flexure one cannot help feeling that it is seldom possible to pick up the necessary formulæ all ready for use, and that those available have limitations. Many engineers who are frequently thrust against concrete design have seen fit to gather their data into more usable form. The method below represents such a condition.

In arriving at a method of design for members under flexure, it is certain that any tables of safe loads, whether single or uniform, are not at all flexible, and will not cover all conditions of loading. In this case, therefore, it is considered that all loading conditions should be represented by bending moments. This, while introducing an additional calculation at the outset, will in the end simplify matters.

TABULATED VALUES FOR THE DESIGN OF REINFORCED-CONCRETE SLABS AND BEAMS

k		$n=10$				$n=12$				$n=15$			
		p	x	j	tjp	p	x	j	tjp	p	x	j	tjp
500	14000	0.00470	0.263	0.912	60.0	0.00536	0.300	0.900	67.5	0.00623	0.349	0.884	77.1
500	16000	0.00372	0.238	0.921	54.8	0.00426	0.273	0.909	62.0	0.00498	0.319	0.894	71.3
500	18000	0.00302	0.217	0.928	50.5	0.00350	0.250	0.917	57.7	0.00408	0.294	0.902	66.3
500	20000	0.00250	0.200	0.933	46.7	0.00285	0.231	0.923	52.6	0.00341	0.273	0.909	62.0
550	16000	0.00440	0.256	0.915	64.3	0.00500	0.292	0.903	72.2	0.00585	0.340	0.887	83.0
550	18000	0.00357	0.234	0.922	59.3	0.00410	0.268	0.911	67.2	0.00480	0.314	0.895	77.4
550	20000	0.00297	0.216	0.928	55.2	0.00345	0.248	0.917	63.2	0.00402	0.292	0.903	72.7
600	16000	0.00512	0.273	0.909	74.5	0.00590	0.311	0.896	84.5	0.00675	0.360	0.880	95.0
600	18000	0.00417	0.250	0.917	68.8	0.00480	0.286	0.905	78.2	0.00555	0.333	0.889	88.8
600	20000	0.00346	0.231	0.923	63.8	0.00395	0.265	0.912	72.0	0.00466	0.311	0.897	83.5
650	16000	0.00587	0.289	0.904	84.8	0.00665	0.328	0.891	94.8	0.00768	0.378	0.874	107.3
650	18000	0.00478	0.265	0.912	78.5	0.00545	0.302	0.899	88.2	0.00634	0.351	0.883	100.7
650	20000	0.00398	0.245	0.918	73.1	0.00455	0.280	0.907	82.5	0.00533	0.328	0.891	95.0
700	16000	0.00665	0.304	0.899	95.7	0.00755	0.344	0.885	106.8	0.00867	0.396	0.868	120.4
700	18000	0.00545	0.280	0.907	89.0	0.00620	0.318	0.894	99.7	0.00718	0.369	0.877	113.3
700	20000	0.00453	0.259	0.914	82.8	0.00520	0.296	0.901	93.6	0.00602	0.344	0.885	106.5
750	16000	0.00748	0.319	0.894	107.0	0.00840	0.360	0.880	118.2	0.00968	0.413	0.862	133.3
750	18000	0.00613	0.294	0.902	99.6	0.00695	0.334	0.889	111.1	0.00802	0.385	0.872	125.8
750	20000	0.00512	0.273	0.909	93.1	0.00580	0.310	0.897	104.0	0.00675	0.360	0.880	118.7
800	16000	0.00832	0.333	0.889	118.3	0.00938	0.375	0.875	131.4	0.01072	0.429	0.857	147.0
800	18000	0.00682	0.307	0.898	110.2	0.00771	0.347	0.884	122.8	0.00889	0.400	0.867	138.7
800	20000	0.00570	0.285	0.905	103.0	0.00648	0.324	0.892	115.5	0.00750	0.375	0.875	131.2

Values to be used in formulæ $h^2 = M/b\ (tjp)$ and $A_s = pbh$.

The straight-line formulæ have been accepted as correct and all values are calculated from them by means of a slide rule. It was considered that the most economical design depended on the balance between the steel and concrete couples, and that when these materials were loaded up to, but not exceeding their predetermined working stresses, and the balance of the couple was maintained, economy of design had been accomplished. The straight-line formulæ are listed below in order to make clear the manner of deriving the formula used in the tables.

The symbols used are as follows: E_s = coefficient of elasticity in steel; E_c = coefficient of elasticity in concrete; $E_s/E_c = n$; A_s = area of steel; A_c, area of concrete; $A_s/A_c = p$ = ratio of cross-sections of concrete and steel; M = bending moment; M_s, resisting moment of steel couple, in inch-pounds; M_c, resisting moment of concrete couple in inch-pounds; d, depth from top of beam to center of steel; b, width of beam and slab considered; k, maximum working stress in concrete in pounds; t, maximum working stress in steel; x, ratio of depth of neutral axis from top of beam to total depth of beam; $j = 1 - x/3$ = ratio to total depth of depth from center of gravity of area under compression of steel; $A_s = pbd$.

The following formulæ have been made use of:

$$x = \sqrt{2pn \times (pn)^2} - pn \qquad (1)$$

$$M_s = tA_sjd \qquad (2)$$

$$M_c = kjxbd^2/2 \qquad (3)$$

$$x = kn/(t + kn) \qquad (4)$$

$$p = kx/2t \text{ (deduced below)} \qquad (5)$$

$$k/t = x/n(1 - x) \qquad (6)$$

It will be noticed from the straight-line formulæ that if any tables of this kind are to be useful, no values of A_s or A_c can be decided until after k and t are determined, and that any formula that is used for the calculation of sizes may depend on either equations (2) or (3), the two moments being made equal in order to preserve the balance of the couple. Therefore, when this balance exists there shall be, to reach the maximum economy of design, just enough concrete and steel used at their assumed maximum working stresses to maintain such balance.

There are cases when a beam, and even a slab is limited in depth, and the steel needs to be increased to lower the neutral axis, bring more concrete into compression and thus make the smaller depth possible, but this is not a frequent occurrence in general design and can be considered a special case.

As said, the balance of the couples of steel and concrete must exist to obtain economical design, and t and k are to operate at their settled working stresses. The manner of arriving at the formula is as follows: $M_s = M_c$. Therefore,

$$tA_sjd = kjxbd^2/2$$

or

$$tA_s = kxbd/2$$

But $bd = A_c$. Consequently

$$tA_s = kxA_c/2$$

and

$$A_s/A_c = kx/2t = p$$

which is equation (5) above.

If M_s and M_c are equal, either may be used for the design of the slab or beam. The value of the latter, however, is more convenient for use.

$$M_c = kjxbd^2/2$$

or

$$d^2 = 2M/kxjb \qquad (7)$$

From equation (5), $kx = 2pt$. Substituting this value in equation (7),

$$d^2 = M/tjpb \qquad (8)$$

Equation (7) might be used and the value for kjx tabulated, but the substitution was made to eliminate the factor 2 and so speed up the calculation by slide rule.

The value of tjp is tabulated, and for the purposes of design may be considered a single quantity depending on values of t and k previously selected.

EXAMPLE

The manner of use of the table is at once apparent, but that there may be no doubt, a case is selected and worked out below.

In a slab design given the following: Live load, 100 lb. per square foot; span, 10 ft.; $n = 12$; k taken at 600 lb. per square inch and t at 16,000 lb. Assuming that slab will be about 6 in., its weight is 75 lb. per square foot. The total load is, therefore, 175 lb. per square foot. Then $M = wl^2/8 = 175 \times 10^2/8 = 2187.5$, or say 2190 ft.-lb. Inserting this value in equation (8), $d^2 = 2190 \times 12/84.5 \times 12 = 25.9$, and $d = 5.09$ in. M is in inch-pounds in the formula, and the value $tjp = 84.5$ is selected from the table. Consequently d is accepted at 5 in., which is near enough, as the values of k and t are low.

The reinforcement required is determined by the formula $A_s = pbh = 0.0059 \times 12 \times 5 = 0.354$ sq. in. of steel required per 1-ft. width of slab. Hence ½-in. round rods 6 in. on centers, giving 0.38 sq. in., will answer the purpose, the slab being 6 in. thick, with the steel placed with the center 1 in. above the bottom of the slab. The vertical stirrups in the beams are figured for horizontal shear, S = total load/$2d$, and are spaced $d/2$ on centers along the length of the beam.

Working of Architects' License Law in Illinois

Elimination of Engineers from the Architectural Field Claimed to Be Greatest Work of Licensing Board

OPERATIONS of the architects' license law in Illinois, which has been on the statute books seventeen years, were summarized recently by Francis M. Barton. secretary of the State Board of Architects, in an address to the Illinois State Convention of Licensed Architects. At present there are 863 licensed architects; 410 were admitted because they were practising before the law went into effect. Of 236 candidates taking examinations, 105 have passed. Thirty architects from other states have received certificates. Due to revoking of licenses only seventeen more architects are practising now than two years ago.

For seventeen years the law had never been rigidly enforced, but the present board pushed a case on the legality of the act through the Supreme Court. Mr. Barton further stated that the board proposes that at least eight cases of different forms of violation of the act shall reach the Supreme Court inside of the next year, at which time the courts will definitely settle forever any question as to the proper interpretation of the wording of the act—that is, the rights of the architect and the rights of the public.

Regarding the violation of city ordinances by architects the board has ruled that as it is a State board and that as different cities and towns have different ordinances it cannot revoke an architect's license because he violated the city ordinance, when the same architect could have built the same structure in other towns or the State without violating any ordinance. Therefore, since this is a State board, all matters pertaining to incompetence or recklessness must be based only on violations of good engineering practice.

ELIMINATION OF ENGINEERS

The board has found its greatest work, said Mr. Barton, to be the elimination from the architectural field of various architectural firms, which operate under an alias, such as architectural engineers, civil engineers, industrial engineers, engineers, designers and builders. Most of these violations are assisted by a licensed architect, who is either financially interested or on a salary. The board has eliminated at least twenty such illegal combinations in the last few months and expects to eliminate all others from the architectural field in the near future. These combinations are to a great extent the result of lack of enforcement of the law, or improper interpretation of the meaning of the wording of the act. Attention is called to the fact that all structural engineering on buildings is part of the architect's work and cannot be performed by others, except under the direction of a licensed architect, and that the architect is responsible for all engineering data shown on his sealed plans, whether performed by him or not.

An appeal was made asking architects to assist in procuring legislation giving the board legal power to stop all buildings that are started in Illinois without plans drawn by licensed architects and all structures where supervision by others than a licensed architect, or a superintendent under the control of a licensed architect, is attempted.

Ultimate Strength of Carbon and Nickel-Steel Models of Quebec Bridge Members

Tension Tests of Reinforced Steel Plates and of Alternating-Stress Members, and Compression Tests of Four Struts

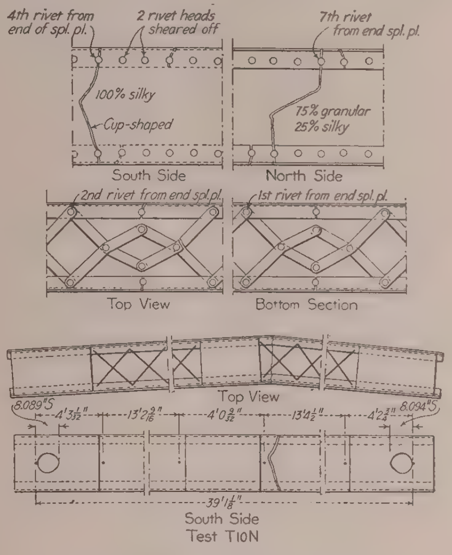
TESTS recently made on eighteen large-scale models of members of long-span trusses of the new Quebec Bridge included comparative tests of nickel and carbon-steel models, described in the issue of March 21, page 333; compression tests of carbon-steel models of the lower-chord pieces with four webs, published in the issue of July 25, page 110, and tests of three other sets of models herein described. These latter were all made on models which, like those previously discussed, were tested to destruction with an accurate and elaborate system of deformation measurements recorded for the study and analysis of the design.

Tension tests were made on a set of four large nickel-steel plates with riveted reinforcements for pin bearings and on two nickel-steel riveted members of a type adapted to resist alternating stresses. A third group of tests were made of H-shaped carbon-steel struts in compression. The distortion of the metal was measured on the members considered as a whole, and locally on the webs and latticed faces and around the pin bearings, to investigate the construction and detailing.

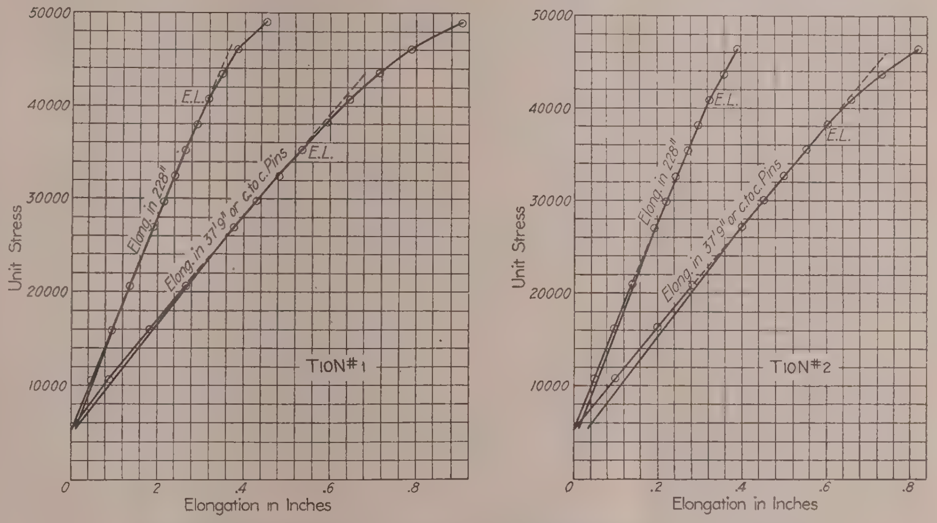
The tension plates developed a maximum elastic limit of 44,452 lb. and a maximum ultimate strength of 79,999 lb. in one of the two pieces broken. The other two pieces endured strains nearly as great without fracture. The alternating stress members under tension stress developed a maximum elastic limit of 41,526 lb., and an ultimate strength of 73,294 lb., breaking in the body of the pieces. The H-shaped compression pieces developed a maximum elastic limit of 21,979 lb., which, as in the case of the previous compression tests, was considerably higher in most cases than the elastic limit determined by measurements on the full lengths of the pieces. The maximum ultimate strength was 35,146 lb.

TESTS OF ALTERNATING STRESS MEMBERS

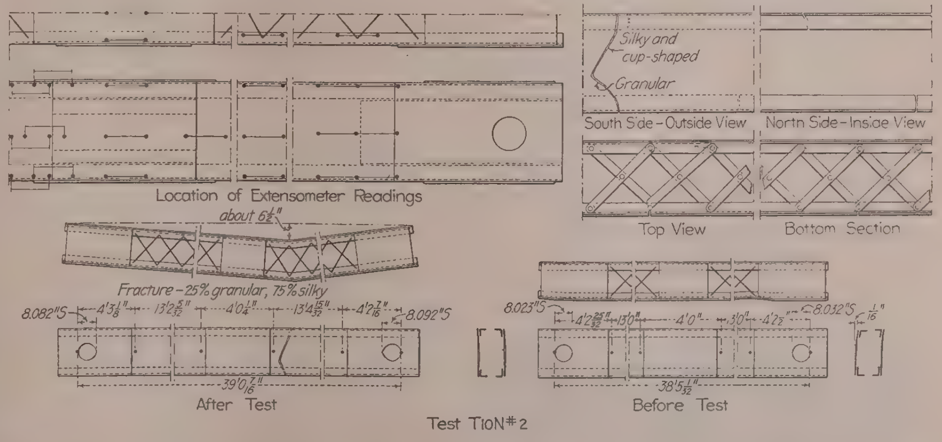
Two nickel-steel models adapted to resist either tension or compression were tested to destruction under tension, developing, like most of the compression models, a higher elastic limit for a measured length in the body of the piece than for the full length. The models were marked T10N-1, and T10N-2, and were duplicates, each being made of two built channels about 24 in. deep and 40 ft. long with their flanges turned in and latticed and their webs bored for 8-in. pins about 37 ft. 9 in. apart. The models had actual gross and net sectional areas, figured from the weight, of 32.51 sq. in. and 26.83 sq. in. respectively. The weight was 7110 lb. Test specimens of the



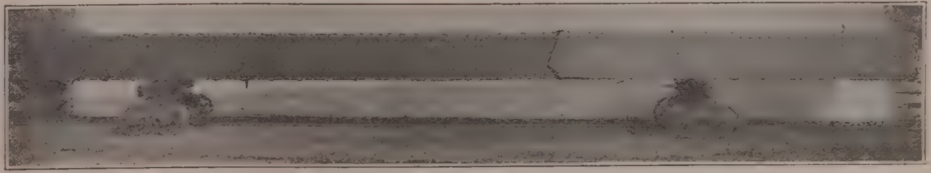
DEFORMATION OF MODEL T10N-1



STRESS-DEFORMATION DIAGRAMS OF MODELS T10N-1 AND T10N-2



DEFORMATION OF T10N-2 AND LOCATION OF EXTENSOMETER READINGS



VIEW OF MODEL T10N-2 AFTER COMPLETION OF TEST angles and plates showed elastic limits of 58,500 and 62,880 lb. respectively, and ultimate strengths of 93,000 and 93,360 lb. The strain gages were applied in 10-in. lengths at twenty-five locations on the flanges and webs and the compressometers were applied to measured lengths of 228 in. in the middles of the latticed faces, and to pinholes 37 ft. 9 in., center to center.

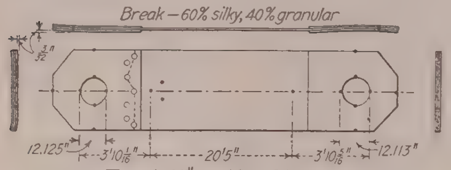
Both models failed by breaking transversely through the body.

TESTS OF PLATES

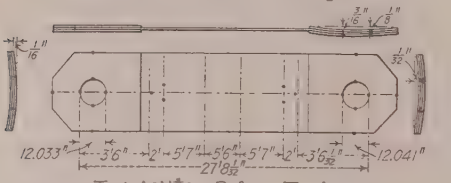
Models A2N-1, 2, 3 and 4 were nickel-steel members made of single plates nominally 36 in. wide, ⅝ in. thick, and 30 ft. long, with reinforcement plates riveted to them for the bearings of two 12-in. pins 26 ft. 8 in. apart on centers. The specimen tests gave elastic limits of 62,880 lb. and 66,520 lb., and ultimate strengths of 93,360 lb. and 89,360 lb. Three of the pieces weighed 3310 lb. each, and one of them weighed 3315 lb. The actual gross area computed from the weight was 22,238 sq. in. Strain gages were applied to one face of the model in twenty-two different locations at the end and in the middle of the piece, to measure the elongation in 10-in. lengths, and four compressometers were ap-

TENSION AND COMPRESSION TESTS OF CARBON AND NICKEL-STEEL MODELS

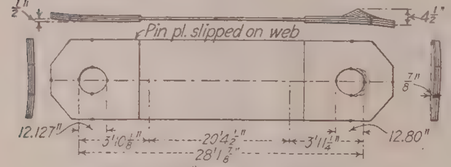
Mark	Kind of steel	Per cent elongation in 20 ft.	Elastic Limit		Ultimate strength	Percentage under normal weight	Maximum vertical deflection at center		Time of test readings	
			In portion at center	In full length			Before test	After test	First	Last
T10N-2	Nickel	.....	41,526	38,757	70,983	...	.....	.....	3.20	6.41
T10N-1	Nickel	.....	41,526	35,989	73,294	...	.....	......	2.13	3.34
A2N-1	Nickel	2.1	......	41,820	79,257	....	.....	......	8.10	10.04
A2N-2	Nickel	1.875	......	36,424	79,556	....	.....	......	1.45	3.36
A2N-3	Nickel	2.0	......	36,422	79,257	....	.....	......	10.00	11.45
A2N-4	Nickel	1.95	......	44,452	77,956	....	.....	......	4.05	6.13
TX18-1	Carbon	.....	20,133	17,257	33,766	0.96	13/64	4 5/64	1.22	4.25
TX18-2	Carbon	.....	20,183	17,257	33,146	0.96	—1/16	+3 7/16	1.23	4.14
TX17-1	Carbon	.....	21,194	21,194	32,576	3.83	—13/32	—7	1.13	4.25
TX17-2	Carbon	.....	21,979	20,409	32,968	3.83	3/16	6 15/32	1.23	4.59



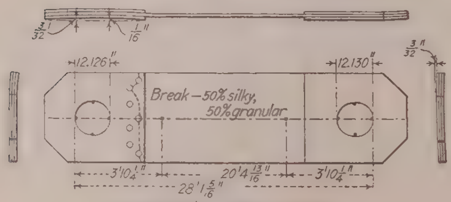
Test A2N#1 – After Testing



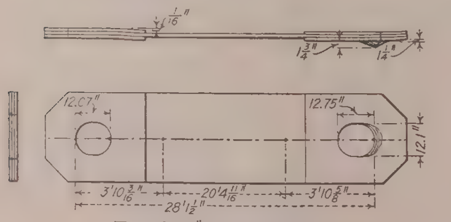
Test A2N#2 – Before Testing



Test A2N#2 – After Testing



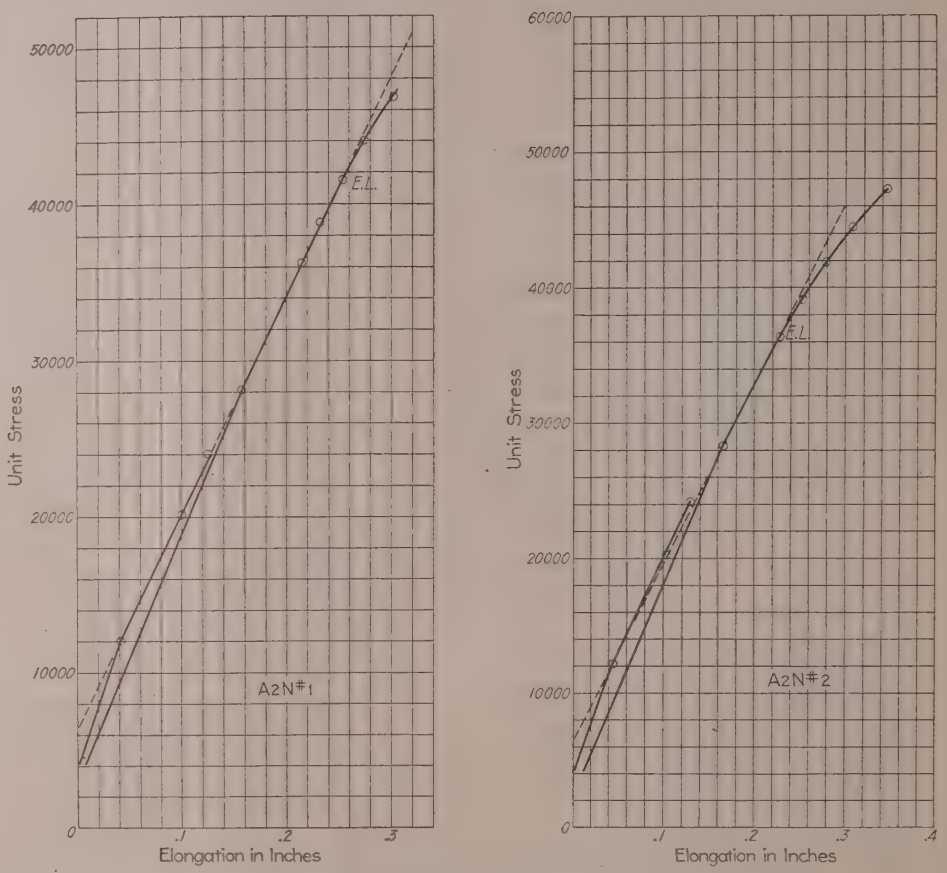
Test A2N#3 – After Testing



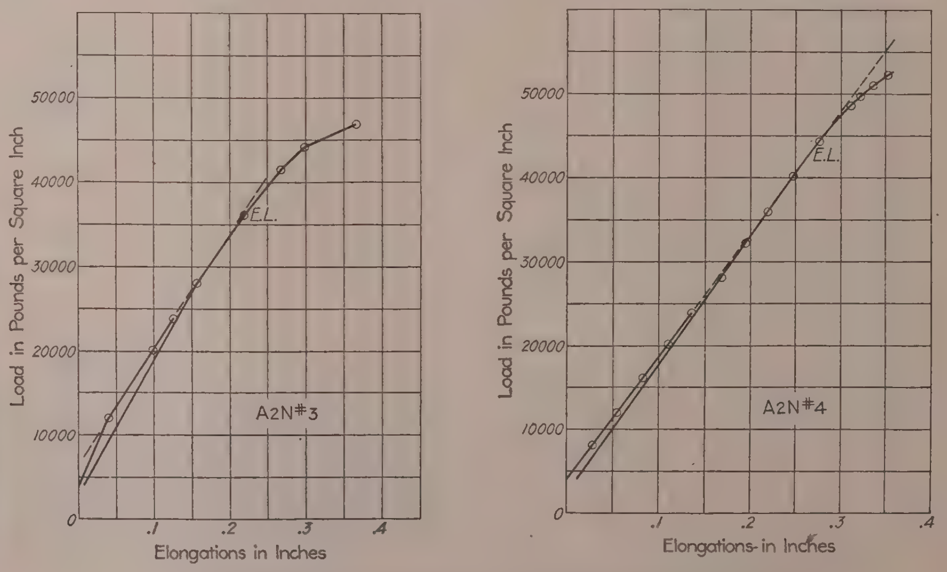
Test A2N#4 – After Testing

DETAILS OF FAILURES OF PLATES

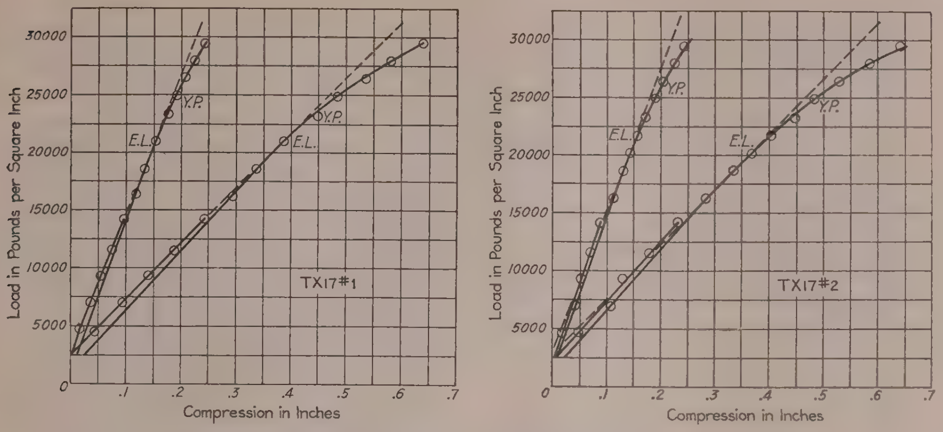
END OF PLATE A2N-4 AFTER TEST



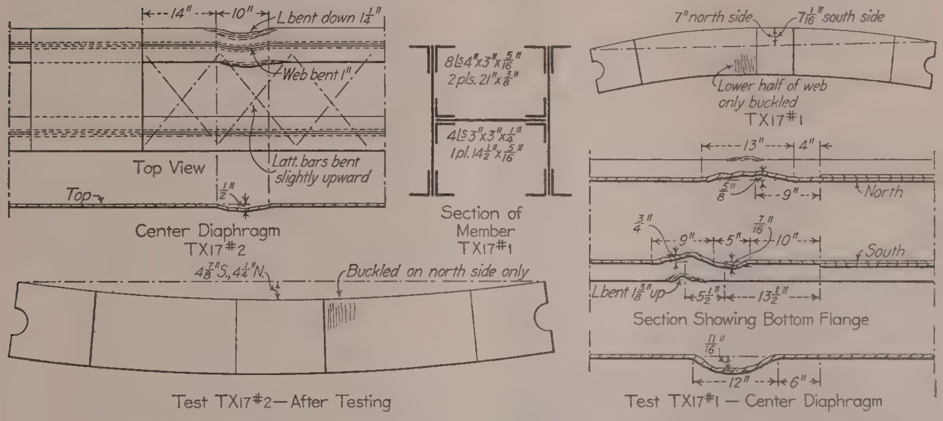
STRESS-DEFORMATION DIAGRAMS OF MODELS A2N-1 AND A2N-2



STRESS-DEFORMATION DIAGRAMS OF MODELS A2N-3 AND A2N-4



STRESS-DEFORMATION DIAGRAMS FOR MODELS TX17-1 AND TX17-2


14"
10"
L bent down $1\frac{1}{4}$"
Web bent 1".
Latt. bars bent slightly upward
Top View
Top
$\frac{1}{2}$"
Center Diaphragm TX17#2
8 Ls 4"x3"x$\frac{5}{16}$"
2 pls. 21"x$\frac{3}{8}$"
4 Ls 3"x3"x$\frac{1}{4}$"
1 pl. $14\frac{1}{2}$"x$\frac{5}{16}$"
Section of Member TX17#1
$4\frac{7}{8}$"S., $4\frac{1}{4}$"N.
Buckled on north side only
Test TX17#2—After Testing
7" north side
$7\frac{1}{16}$" south side
Lower half of web only buckled
TX17#1
13"
4"
$\frac{5}{8}$"
9"
North
$\frac{3}{4}$"
9"
5"
$\frac{7}{16}$"
10"
South
L bent $1\frac{3}{8}$" up
$5\frac{1}{2}$"
$13\frac{1}{2}$"
Section Showing Bottom Flange
$\frac{11}{16}$"
12"
6"
Test TX17#1 — Center Diaphragm

SKETCHES SHOWING DEFORMATION OF TX17-2 AND TX17-1 DURING TEST

plied on both edges and on the center line to measure the extensions in a length of 200 in.

Models A2N-3 and A2N-1 failed by fracture through transverse rows of rivets in end reinforcement plates. Models A2N-2 and A2N-4 failed by dishing around the pin holes.

COMPRESSION TESTS OF H-SHAPED MODELS

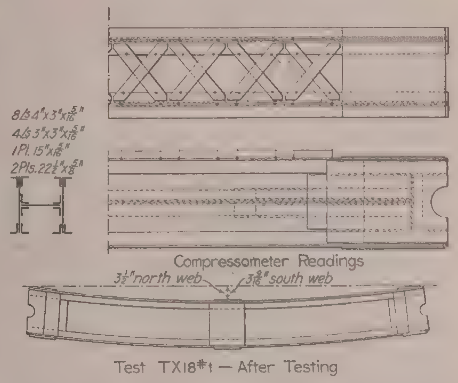
The four H-shaped carbon-steel models marked TX17-1 and 2 and TX18-1 and 2, represented respectively vertical and inclined posts in the cantilever arms of the trusses. They were located as indicated in the general diagram published in the issue of March 21. Each was made of two built I-beams with latticed flanges and solid webs connected by an I-shaped horizontal latticed diaphraghm riveted to them on the center longitudinal lines. At the center point they were spliced by web and flange cover plates, and at the ends the vertical webs were reinforced and had half-hole pin bearings. All of them were about 21 in. wide and 21 in. deep over all. The TX17 models had a nominal cross-sectional area of 42.75 sq. in., a weight of 8950 lb., a length of 46 ft. 6 in. center to center of pinholes, and a ratio *L/R* of 78. The TX18 models had a nominal area of 56.65 sq. in., weighed 9550 lb. each, were 34 ft. 6 in. long center to center of pinholes and had a ratio *L/R* of 58.

The TX17 models were counterbalanced by 2000-lb. weights attached to them at the quarter and center points, and the TX18 models were similarly counterbalanced by 870-lb. weights. The distortions produced by the test loads were measured by strain gages applied to the lattice bars, flanges and webs of the models on short measured lengths, and by the compressometers applied to measured lengths of about 19 ft. on the latticed faces and to the full length between pin centers on the webs of the models.

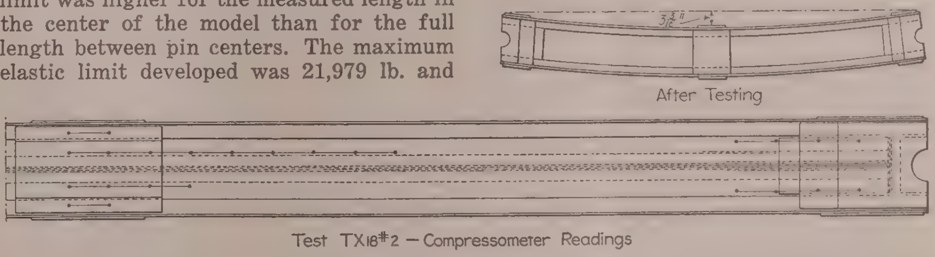
All of the pieces failed by bending at the centers, accompanied in two cases by comparatively small buckling of the webs near the center. In all cases but one the elastic limit was higher for the measured length in the center of the model than for the full length between pin centers. The maximum elastic limit developed was 21,979 lb. and the maximum ultimate strength, 35,146 lb.

C. N. Monsarrat is chairman and chief engineer and Ralph Modjeski and C. C. Schneider are the other members of the board of engineers of the Quebec Bridge. The tests were made for the St. Lawrence Bridge Company, of Montreal, contractors for the superstructure of the new Quebec Bridge, by the Phoenix Bridge Company, John Sterling Deans, chief engineer, P. L. Szlapka, designing engineer, and Charles Scheidl, assistant engineer in charge. The tests were made under the direction and personal supervision of James Howard, engineer physicist, Bureau of Standards, Washington, D. C.

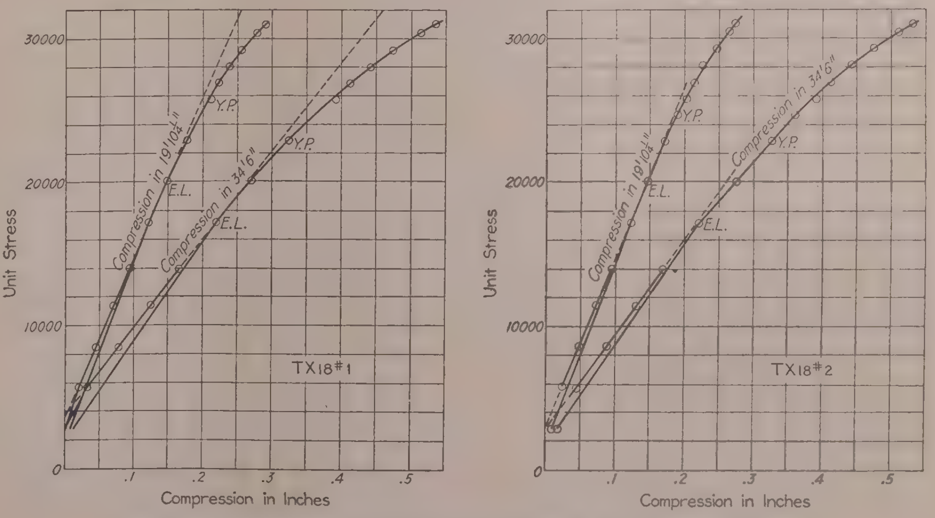
WATER FOR IRRIGATING cannot be judged solely by the taste, states Dr. A. E. Vinson, of the University of Arizona Agricultural Experiment Station, since an injurious amount of black alkali does not reveal itself in this way. For drinking purposes such waters are not harmful. The importance of the quality of irrigating waters is being emphasized by Dr. Vinson.


8 Ls 4"x3"x$\frac{5}{16}$"
4 Ls 3"x3"x$\frac{5}{16}$"
1 Pl. 15"x$\frac{5}{16}$"
2 Pls. $22\frac{1}{2}$"x$\frac{5}{8}$"
Compressometer Readings
$3\frac{1}{2}$" north web
$3\frac{9}{16}$" south web
Test TX18#1 — After Testing

STRUCTURE, LOCATION OF COMPRESSOMETER READINGS AND DEFORMATION OF MODEL TX18-1



DEFORMATION OF TX18-2 AND LOCATION OF COMPRESSOMETER READINGS



STRESS-DEFORMATION DIAGRAMS FOR MODELS TX18-1 AND TX18-2

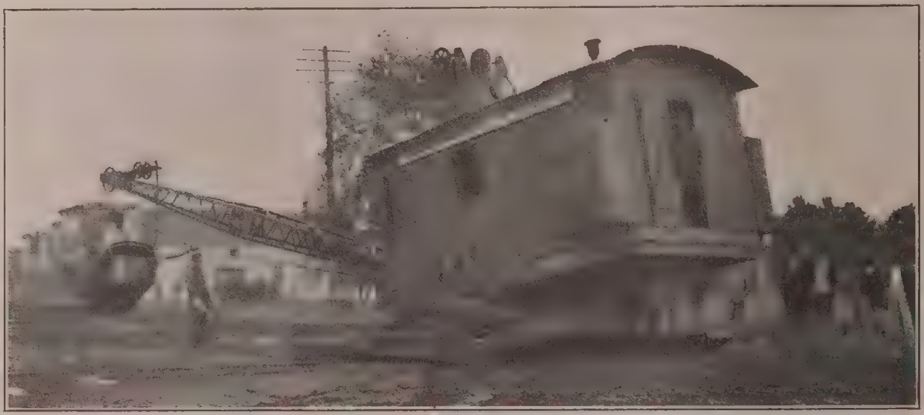
Excavating Machine Walks to Its Work in Iowa Town

Dragline Excavator Equipped to Take 8-Foot Steps, Moving 2½ Miles per Day

INHABITANTS of the little town of Stratford, Ia., awoke one morning recently to see a large dragline excavator hopping down the main street taking 8 ft. hops and progressing at the rate of 2½ mi. per 9-hr. day.

The accompanying photograph shows the excavator leaving the railroad station on its 5½ mi. jaunt to a drainage ditch located on the outskirts of Stratford. Where cement sidewalks were encountered in the town, 6 x 6-in. timbers were placed on each side of the walk and the excavator passed over without touching them. Toward the end of its journey the machine left the beaten path of the highway and crossed several farmers' fields.

Only one man was used in its operation and the sole cost of getting it on the work from the depot was that of the operator and fuel. A description of its operation and construction was published in the Current News section of the Engineering Record of Aug. 1. The machine was shipped from the Monighan Machine Company, of Chicago, assembled except for a boom, A-frame, and house which were placed in position before it started on its saunter to the job.



DRAG LINE EXCAVATOR "WALKING" TO ITS WORK FROM RAILWAY STATION

Tests of Concrete Road Slabs by New York Highway Department

LABORATORY tests of cubes representing all the concrete roads being laid in New York State have been made during 1914. The average breaking stress is high and the uniformity of the specimens is satisfactory. Engineers of the State Highway Commission make the cubes on the job, taking material from the mixer for two cubes for every 500 cu. yd. of concrete. A 1:1½:3 mixture is used for all road slabs laid in the State. The cubes are cured in moist sand for twenty-one days and are then packed in pairs and sent to the testing bureau at the Albany office. A week later they are tested in a compression machine. About 200 mi. of concrete roads will be built by the department this year, and up to Oct. 1 about 440 cubes had been tested. The average breaking stress for these is 3600 lb. per square inch, considered an excellent performance for twenty-eight day tests. The maximum stress observed was more than 5500 lb., which is the capacity of the machine.

Philadelphia Association Would Regulate Employment of Engineers in Public Service

Plan to Prevent Engagement, Through Ignorance or Political Motives, of Incompetent or Unscrupulous Engineers—Engineers' Club Also Reports

EVER since a commission of engineers, appointed by the Governor of Pennsylvania, submitted a draft of a proposed bill in order to facilitate discussion as to whether or not it is desirable to license engineers in that State, local interest in the subject has been exceedingly keen. The provisions of this tentative bill were outlined in the Engineering Record of Oct. 24, page 450. The Philadelphia association of members of the American Society of Civil Engineers, at a recent meeting, appointed a committee to draw up a report embodying the views of that organization and this report, published in this journal Oct. 31, page 484, opposed not only the bill offered for discussion by the State commission but also any general licensing measure. This committee reported in favor of protecting public interests, not by general licensing of engineers but by the creation of a State engineering department, board or commission with powers to approve or reject any plans for engineering works except those designed and constructed by municipalities and approved corporations, such as railroad companies. The report, however, favored the licensing of surveyors and other classes of technical men whose duties are of a definite and restricted nature in fields where incompetency would be attended with property loss or expensive litigation. In a supplementary report dated Oct. 26 the same committee proposed certain measures governing the employment of engineers in the public service. It is signed by Prof. Edgar Marburg, chairman, John Sterling Deans, Richard L. Humphrey, H. R. Leonard, Henry H. Quimby, S. M. Swaab, Edward B. Temple and Samuel Tobias Wagner. Mr. John W. Ledoux endorsed the general principles of the report but does not approve it in full detail. An abstract of this report is given below and is followed by a report by a committee of the Engineers' Club of Philadelphia, which opposes licensing.

Supplementary Report

In its original report the committee recommended the creation of a State engineering department, board or commission. It desires now to point out that, irrespective of the creation of such a department, it is of fundamental importance that the State should recognize its responsibility for safeguarding the interests of the public in connection with engineering works designed, operated and maintained by engineers in the employ of the State, counties, municipalities or boroughs.

The inadequacy of existing laws and ordinances is evident from the fact that outside of the cities of the first and second class—Philadelphia, Pittsburgh and Scranton—the usual conditions governing the employment of engineers are a majority vote of county commissioners or local council, and little or no direct responsibility under the law on the part of the engineer thus employed. These conditions hold out no assurance of professional competency and integrity on the part of such engineers, even though incompetency in connection with their duties is likely to result not only in the waste of public funds, but in the jeopardy of human life, health and safety. The existence of these conditions is discreditable to the State of Pennsylvania, and it is earnestly recommended that adequate remedial measures be promptly enacted.

Remedial Measures

In general it is desirable that the employment, retention or discharge of engineers in public service should be governed by the same principles as under private corporate management. The following suggestions are offered as indicative in a general way of the requirements of the situation, without aiming at completeness or the best means of adapting them to existing conditions:

Civil Service Examinations.—It is highly desirable that the appointment of engineers and technical men in general, with duties of a nature in which competency may be readily determined by examination, should be subject to State or municipal civil service regulations. In cities of the first and second class, such civil service examinations may properly be conducted under independent management. For other municipalities, counties and boroughs it is desirable that such civil service examinations be conducted by a State department in order that these examinations may be governed by reasonable and consistent standards, and that a single body may be charged with the enforcement of such standards.

Exemptions from Examinations.—It is desirable that appointments to engineering or technical positions above a certain rank should not be governed by competitive civil service examinations, but that the appointees should be chosen on the basis of their professional record. It is desirable that such appointments should be made either by the State civil service examination department direct, or at the initiative of designated State officers, but with the approval of the State civil service examination department.

Other functions of the State civil service examination department are desirable. The State civil service examination department should be authorized to investigate charges of incompetency or official dereliction on the part of engineers and other technical men appointed through civil service, except employees of cities of the first and second class, and that it alone should be empowered to disqualify such public servants, and only for adequate cause. It is further desirable that that State civil service examination department should act in an advisory capacity in connection with the employment of consulting engineers or experts for special temporary engagements, and that no engagements of that character should be legal without its approval.

This plan would tend to prevent the engagement through ignorance, or from interested or political motives, of incompetent or unscrupulous engineers and would likewise tend to facilitate the approval of plans for public works on the part of the several State departments concerned. It would also serve to minimize abuse under the system by which nominally free engineering services are rendered by commercial concerns, and by which patented schemes and devices of questionable merit, or of unnecessary cost, are prescribed in specifications for public works. Finally, it should serve as an effective check upon the prevailing method by which professional engagements are made a matter of competitive bidding. This system, which cannot be too strongly condemned, places a premium on incompetency and unscrupulousness at the expense of public interests. Experienced, able and reputable engineers refrain from participating in such competitions and would, in fact, have little or no chance of obtaining a commission under its operation.

It should be one of the duties of the State civil service examination department to educate public and official sentiment as to methods of procedure in the employment of competent engineers, and as to the danger to public interests through the engagement of incompetent men from mistaken motives of economy or other reasons.

Conclusions

In conclusion the committee recommends the creation of a State department of public works which shall be in charge of the administration of the above proposed civil service examination system and the supervisory system of plans and inspection of engineering works, and in which shall be centralized such other matters relating to public engineering activities as may seem proper.

Engineers' Club Report

The supplementary report just quoted has received the endorsement of the Engineers' Club of Philadelphia. This organization also has submitted a report on the subject signed by Henry Leffman, chairman, G. T. Gwilliam, Edgar Marburg, Coleman Sellers, Jr., S. M. Swaab, W. P. Taylor and John C. Trautwine, Jr. Its main provisions are these:

First, that it is highly desirable that legislation should be enacted designed to protect life and property by regulating the design, construction and operation of engineering works. Second, that the act proposed by the State commission will not serve to accomplish these purposes. Third, that these purposes will be accomplished by an act embodying the following features:

1. The creation of a State engineering department, board or commission by which engineering designs which may involve public safety would have to be approved before execution. This department should also be charged with the inspection of engineering works during construction, at such intervals and to such extent as may be deemed proper.

2. The exemption from the supervision of this department work designed and constructed by municipalities and approved corporations, such as railroad companies, etc., which are not only legally responsible for, but have an immediate and lasting interest in engineering operations conducted on their behalf and under their supervision.

3. The licensing of county surveyors and other surveyors in independent practice. Fair examinations for surveyors can easily be set, which would serve to exclude incompetent men whose incompetency would be likely to entail property losses and expensive litigation.

4. The licensing of other classes of technical men whose duties are of a definite and restricted nature in fields where incompetency would be attended by results similar to those just mentioned in connection with surveyors, and in which competency may readily be determined by examinations.

Book Reviews

The American Railway Engineering Association has published in a pamphlet of twenty-seven pages the conventional signs adopted by the association for use on railway profiles, right-of-way and track maps and structural plans. These symbols, it will be recalled, are prescribed by the Interstate Commerce Commission for use in so far as they may be applicable on maps and profiles submitted in connection with the Federal valuation. (Chicago, American Railway Engineering Association, 25 cents.)

Bulletin 62, revised edition, of the Bureau of Railway Economics is a bibliography of publications pertaining to government ownership of railways. It contains eighty-eight pages, subdivided geographically and dealing with various continents and countries, the works listed being in a number of languages. About 750 authors are mentioned. The bulletin aims "to include references to all available literature on the subject—good, bad and indifferent—for and against government ownership."

Water supply paper 364 just issued by the U. S. Geological Survey, contains 203 water analyses tabulated by F. W. Clarke, chief chemist. Most of these analyses have been published elsewhere but many of the additional documents are out of print and are, therefore, obtainable with difficulty. All the analyses given in the record are stated in terms of ions and so represent the actual results of experiments with the minimum of hypothesis. Many of the waters are commonplace in character but some are most unusual. For example, the Devil's Inkpot in Yellowstone Park is essentially a solution of ammonium sulphate and the Shoal Creek springs in Missouri contain a remarkable proportion of zinc.

The U. S. Geological Survey has issued two statistical reports of interest to engineers, the first on the production of lime in 1913 and the second on the production of asphalt, related bitumens and bituminous rock in 1913. The first is a pamphlet of sixteen pages, giving the total value of the production by States, and the average price per ton in each. There are statistics on the number of kilns in each State, the character of fuel used and a long quotation from a paper by Dr. Lazell on hydrated lime. The pamphlet closes with a bibliography of the subject. The paper on asphalts contains only eight pages and is confined almost entirely to statistics of production of the different classes of material in the United States and foreign countries. Some information is given also as to the conditions governing production in the chief producing States of the Union. (Washington, D. C., U. S. Geological Survey.)

The Proceedings of the Second Annual Convention of the National Association of Corporation Schools, held in Philadelphia, have just been published in a 700-page 6 x 9-in. volume. The convention was the occasion of the presentation of some very remarkable papers on methods employed by large corporations in the education of their employees. The discussions, likewise, were virile and to the point. Separate meetings are devoted to selling schools; accounting, financing and purchasing schools; office-work schools; vocational guidance and welfare work, including physical efficiency, hygiene and sanitation. The sessions were participated in by those best qualified to discuss them, corporations throughout the country sending the members of their staffs in charge of their educational work. The volume, therefore, forms a very valuable compendium of the present status of employee education by corporations. (New York City, Irving Place and 15th Street, National Associations of Corporation Schools, $5.)

ANALYTIC GEOMETRY. By L. Wayland Dowling, Associate Professor of Mathematics, University of Wisconsin, and F. E. Turneaure, Dean of the College of Engineering, University of Wisconsin. Cloth, 5½ x 8 in.; 266 pages; 140 illustrations. New York, Henry Holt and Company. $1.60.

Analytic geometry is the most important of the elementary mathematics, as it forms the introduction to the higher mathematics. To enable the student to grasp calculus and apply it practically his knowledge of analytic geometry must be good. The first part, plane analytic geometry, is extensive. The chapter on loci of the second-order equations not in standard form analyzes this problem in a clear way, which will be appreciated by students, who generally dread problems of this nature. The chapter on loci of higher order contains the more common higher plane curves. The lemniscate, strophoid, cassinian ovals and other higher plane curves have not been included in this chapter, but distributed throughout the text where they may serve as illustrative examples. The part on solid analytic geometry is brief and serves to give the student an outline only. The subject is one which may, to better advantage, be taught later when the student has a command of calculus.

STRENGTH OF MATERIALS. By H. E. Murdock, Irrigation Engineer, U. S. Department of Agriculture. Cloth, 5 x 7½ in.; 352 pages, 156 illustrations. New York, John Wiley & Sons, Inc. $2 net.

This is the second edition of a book favorably reviewed in this journal in 1912. While covering the ground usual in engineering courses, and generally described by the title "Mechanics of Materials," rather than the one used for this book, the work does not use calculus extensively. In fact, it was written with the idea of avoiding the use of the calculus as much as possible. For those desiring a mathematical treatment of the deflection of beams, a special chapter giving the mathematical derivation of the formulas for deflection has been inserted. Graphic methods are used quite extensively. Characteristics of the book are a very thorough discussion of stresses in beams and the provision of a great number of well selected examples. The latter feature is one that will be much welcomed by teachers. The subject is covered under the following headings: Material of construction; direct stresses; direct stresses—applications; riveted joints; beams—external flexural forces; beams—internal flexural stresses; stresses in chimneys, dams, walls and piers; graphic integration; deflection of beams—elastic curves; elastic curves—cantilever and simple beams and beams fixed at both ends; elastic curves—overhanging, fixed and supported, continuous beams; elastic curve of beams determined by the algebraic method; secondary stresses; columns and struts; torsion; repeated stresses, resilience, hysteresis impact; reinforced-concrete beams; reinforced-concrete columns; centroids and moments of inertia of areas.

PRINCIPLES AND PRACTICE OF ELECTRICAL ENGINEERING. By Alexander Gray, assistant professor of electrical engineering, McGill University, Montreal, Canada. Cloth, 6 x 9 in.; 391 pages, 449 illustrations. New York, McGraw-Hill Book Co., Inc. $3 net.

The book is based on a lecture and laboratory course given to the senior civil, mechanical and mining engineering students at McGill University. It is intended, therefore, for men who have but limited time in which to acquire a grasp of the fundamentals which are necessary for the understanding of electrical apparatus. The higher theoretical and mathematical treatments customary in works intended expressly for electrical engineering students are, therefore, avoided. The book gives a self contained lecture and laboratory course. In the laboratory section, complete references are given to the theory and the purpose of each experiment and these references do not go beyond the text contained in the body of the work.

The books leads up through elementary considerations of electro magnetism, magnetic circuits and the magnetic properties of iron to direct-current machinery. Following the consideration of the characteristics of direct-current motors, there is a helpful chapter on motor applications, indicating the sort of motor desirable for different classes of service, thus emphasizing the importance of the subject of characteristics previously studied. After rather hasty treatment of various auxiliaries, alternating-current machinery is taken up. The treatment, it can easily be judged, is necessarily brief, but unquestionably a student who goes through the volume will be in a position to take up further study of electrical machinery, not too complicated, by himself, at least to the extent generally required of the civil and mining engineer.

SCIENTIFIC MANAGEMENT. A collection of the more significant articles describing the Taylor system of management. Edited by C. B. Thompson, lecturer on manufacturing in Harvard University. Cloth, 6 x 9 in., 878 pages, numerous printed forms in the text. Cambridge, Mass., Harvard University Press.

At first glance one wonders why such a weighty volume, containing merely reprints, should have been issued. The literature of scientific management is already so large that one seeks for condensation and summary rather than amplification and detail in a work professing to be, not original, but only a compilation. On examining the individual papers, however, it is seen that the editor has brought within one set of covers much valuable material. Both the theoretical and practical aspects of the subject are well presented. The articles on the latter phase are particularly valuable, for they would serve as guides to those who would venture alone to reorganize their businesses. The volume is not one which will appeal to those who have followed closely the development of the scientific-management movement. It is rather for the man who just now makes his acquaintance with the subject through the books of Taylor or Emerson and is so convinced of the possibilities it holds out in his own work that he wishes to make a thorough study of the subject. It will save him the trouble of going through numerous periodicals and will also place at his disposal a number of articles out of print.

It is not possible to enumerate the principal contributions without slighting others that deserve mention, and the list of titles and authors is too long for the space available here. There are reprints of articles by such well known exponents of modern efficiency methods as Frederick W. Taylor, H. K. Hathaway, J. M. Dodge, H. L. Gantt and Carl C. Barth. There are many criticisms, also, of scientific management, both in theory and as to practical results.

Two chief criticisms must lie against the work. First, it could have been considerably shortened without lessening its value; some of the reprints are but amplifications of others or describe practice differing only in detail. As a rule one is safe in condemning articles which reprint a great many forms. They are excellent space fillers, but any student who clearly grasps the subject is competent to devise his own forms. They are the merest detail in any method of even satisfactory management.

The second criticism is that little or no attention is given in the book to some of the work done by Harrington Emerson and his associates. The work is, professedly, devoted exclusively to the Taylor system, but it is certainly regrettable to find a book forming Volume I of the "Harvard Business Studies" confined to only one phase of an important subject. The editor himself admits that Mr. Emerson's writings have done much to popularize scientific management, and while there is petty jealousy on the part of the Taylor school toward Mr. Emerson and his associates and while the latter has suffered because of some unfortunate advertising with which his name has been connected, a university which carries on its shield the word "Veritas" is expected to present all the fullness of truth which the subject holds. There is no denying that Mr. Emerson made a very conspicuous success of the work on the Santa Fé, supercilious writers in—and also editors of—technical periodicals to the contrary notwithstanding. That those in charge of the Santa Fé efficiency work lost their heads after Mr. Emerson's firm hand was removed and applied it to departments to which he never contemplated its extension should not reflect upon the work he did.

Letters to the Editor

A Question of Society Ethics

Sir: I desire to strongly protest against the two editorials which appeared in the Oct. 17th issue of the Engineering Record. These editorials are entitled "A Question of Society Ethics" and "Societies and Specifications."

They attack my fitness for the position of chairman of the sub-committee on sheet asphalt paving specifications of the American Society of Municipal Improvements and plainly intimate that I prepared the committee report and that it was adopted without examination or opportunity for consideration and that I was active in opposing an effort to secure time for the consideration of the report by the society at large. They assert it to be a fact that the report was made by the chairman and one other active member of the committee and that the specifications themselves were drawn up in the interests of clients of mine. They further assert that the report of my committee completely reverses in a very important particular the position of the Association for Standardizing Paving Specifications.

They also attempt to dictate to the A. S. M. I. what its membership shall consist of and suggest that it follow the procedure of the American Society for Testing Materials, or, better still, that it turn over the preparation of specifications to the latter society, and conclude by stating that "the influence of the A. S. M. I. has been very greatly lessened because of some specifications it has passed, and engineers familiar with its operations are now quite distrustful of what it puts forth."

If I were not entirely aware of the source of this attack and the reasons for it and the commercial interests back of it, I should be inclined to wonder at its violence and the extreme solicitude displayed for the welfare of the society. So far as the attack on me is concerned, my past record as a member of the A. S. M. I., during which I have acted at various times as chairman and member of the sub-committee on sheet asphalt specifications, is open and known to the society and proves that I have always fought for open specifications and against "jokers" of all kinds and have never signed a committee report which was not of this character. If, knowing my record, the society saw fit to again make me chairman of this committee, I regard it as ample evidence that the attack on me in the editorial referred to is as baseless as it is untrue and that I am fit to be chairman of one of its important sub-committees and have lived up to the high standard of the society.

The composition of my committee shows that out of eight members all but two were city officials. Out of the five members who actually participated in the making of the report at Boston, three were city officials who were as well posted on the subject as any in this country and it is an insult to their ability and standing to suggest that any one man could or did dominate them in any improper way.

It would appear more fitting to leave the statements of the actual records and proceedings of the committee to its members rather than to have me go into it in detail, but I wish to assert emphatically that the report was in every sense a joint one, although I should be proud to claim it for my own.

The committee did not offer a new set of specifications. They merely revised those adopted by the society in 1911, 1912 and

1913, and, while the revision required much thought and care, it did not change the existing specifications in any material way and under them, as you must know if you are at all informed in the matter, every good paving asphalt is freely admitted without discrimination, stated or implied, in favor of or against any one. The specifications as amended were first submitted to the general specifications committee and were approved by them before they were or could be presented to the society—surely not an evidence of undue haste. They are on record and speak for themselves and I defy anyone to prove that they are improperly drawn in favor of anyone, whether they be clients of mine or otherwise.

One of the editorials under discussion states that it does not propose to go into the merits or demerits of any report, but it does assert it to be a fact that the asphalt specifications are very much in the interests of certain manufacturers. In view of the specifications adopted by the A. S. M. I., it is apparent that either the writer of the editorial was not familiar with them or else did not dare print them as they would infallibly have demonstrated the falseness of his statements concerning them.

Far from being active in opposing full consideration of my committee's report, I urged it in every way. The motion which I did oppose was one which proposed that, contrary to the regular procedure of the A. S. M. I., the report be accepted without discussion *but not adopted for a whole year* and that, instead, the society *should adopt without discussion and examination* the specifications of a totally different society!

As to the important particular in which the American Society of Municipal Improvements specifications differ from those of the Association for Standardizing Paving Specifications, practically the sole effective difference, so far as asphalts are concerned, lies in the fact that in the A. S. M. I. specifications no classification of the different kinds of asphalts is made and the same tests are applied to all, whereas in the S. P. S. specifications they are divided into three classes and certain tests are called for under one class that are not required for other classes. The same tests, however, for all classes are applied to the asphalt cements, and, except that the A. S. M. I. specifications call for a minimum of 30 cm. ductility as against 20 cm. in the S. P. S. specifications, the tests and requirements in both specifications are practically identical and any asphalt admitted under one would be admitted under the other without let or hindrance. From this it will be seen that the "important particular" is the classification. Inasmuch as the classification is more or less an arbitrary one and has no bearing upon whether or not the asphalt is admitted and would therefore appear to be of no value in a specification *and because it has been misused by a certain manufacturer,* it was decided to continue our specifications in their original form and not to follow the practice of the S. P. S. in this respect.

In the ultimate analysis, therefore, the only basis for these misleading and abusive articles is this "important difference" between the two sets of specifications and here I will follow the precedent set and "assert it to be a fact" that herein lies the keynote to the whole disgraceful attack.

The childish attempt to show your editor's inability to distinguish between a consulting engineer and one retained by a single corporation is so transparently an effort to carry his point at the expense of common sense that it is not worth combating and the same may be said of the attempt to besmirch the American Society of Municipal Improvements by the unsupported assertion that its influence is lessened and engineers are distrustful of it.

As to the recommendation that the American Society for Testing Materials be requested to draw up specifications for the A. S. M. I., I submit that it would appear that a society of over four hundred active members largely composed of the leading city engineers in the country, as is the A. S. M. I., would be better able to draw up paving specifications than would the A. S. T. M.

The same total indifference to facts and lack of knowledge which characterizes the remarks on the American Society of Municipal Improvements and its specifications is shown in the confident assertion that the American Society for Testing Materials is free from the grave dangers which have been pointed out as existing in the A. S. M. I. The editor evidently does not know that the chief objection which he has raised against the A. S. M. I. committee on sheet-asphalt specifications would hold against a similar committee in the A. S. T. M. I am a member of the A. S. T. M. and a member of a number of its committees and am recognized by that society as an unattached expert and as such am classified as a consumer and not a producer. I am, therefore, eligible in it for the position of chairman of a committee on sheet-asphalt specifications.

Taking the viewpoint most favorable to your paper, the publishing of these editorials can only be ascribed to the fact that you were totally misinformed in the matter and were deliberately misled by others who attempted to use you as a cat's-paw for their own commercial advantage.

I am willing to accept this view and am giving you, therefore, the first opportunity to correct your error and trust that as a matter of simple justice you will give this letter the same prominence as you accorded to the editorial referred to.

FRANCIS P. SMITH,
Chairman, Sub-committee on Sheet
Asphalt Specifications, A. S. M. I.
New York.

Sir: There were two editorials in your issue of October 17 which reflected so seriously upon the work of the American Society of Municipal Improvements in regard to its recent meeting in Boston that they seem to require special answer, and as the criticisms seem to be aimed entirely at the work as regards specifications, it seems proper that the committee on standard specifications should make the reply.

The constitution of the society regarding membership reads as follows: "Any engineer, officer or director who shall have charge or supervision over or be employed as a consulting engineer, or any public municipal, county or state department work, or any mayor, councilman or other municipal official in any municipality is eligible to active membership in this Society."

This society has been organized and at work for twenty years, and has among its members the oldest and best known municipal and consulting engineers in the country, and never before has its work been impugned.

While the methods regarding specifications have been severely criticised in your editorials, the work of the sub-committee on asphalt paving specifications has received the greatest condemnation.

The society has a committee on standard specifications. There are also sub-committees on the different kinds of paving and sewer specifications, which committees make their reports to the main committee, which in turn hears the same and presents the specifications as agreed upon to the society for action. Your editorial, while drawing an unfavorable conclusion from the fact that the asphalt specifications adopted at Boston are different from those adopted by the Association for Standardizing Paving Specifications, has entirely overlooked that out of the eight members of the sub-committee on asphalt paving specifications of the Boston convention, four were members of the committee of five of the Association for Standardizing Paving Specifications.

There is also another advantage, the additional safeguard provided in the committee work of the American Society of Municipal Improvements over the Association for Standardizing Paving Specifications in having all the specifications passed upon by two committees, each of which gave hearings before the specifications were submitted to the convention.

The report of the sub-committee on asphalt paving was presented to the main committee, which was composed of five engineers, all city officials of prominent cities, and three of the members of this committee were in attendance at Boston. After receiving the report of the sub-committee and making certain minor changes, the main committee approved it, and it was presented at the meeting of the society, all changes explained in great detail, and finally adopted.

The early asphalt pavements were laid with natural asphalts, when it was not required to go into details as to the qualities of the material, as they were well known. When, however, asphalts manufactured from oils were placed on the market, it was necessary to make requirements which would shut out asphalts which were not suitable for paving purposes. The letter hereto attached [printed below] from the municipal members of the sub-committee present at the meeting seems fully to cover all of the criticisms in your editorials as to the effect of the specifications as well as the work of its chairman.

The editorials further say: "The wood block specification now on record is of rather malodorous memory, and, as this journal understands it, an amendment thereto that was, to say the least, no moral improvement was barely postponed at Boston."

The main committee at the Boston meeting carefully considered the specifications presented by the various sub-committees; protracted hearings were given at which the members of the sub-committees, and others interested, were heard.

In all cases where, in the opinion of the main committee, further consideration was advisable before presenting any specification for adoption by the society, the main committee, with the full concurrence of the sub-committee, presented the specifications to the society, with recommendations that they be printed but not adopted, and laid over for further consideration.

Such action was taken in the case of specifications for wood block, bituminous concrete and for two sections of the sewer specifications.

The committee fully understands the meaning of the word "malodorous," but it does not see its application in this matter, as the wood block specifications of the society have never received serious criticism. The chairman of the sub-committee who made the report at the Boston meeting on wood block pavements is assistant city engineer of a large western city, and is a man who has had more to do with the laying of wood-block pavements than any other municipal engineer. The work under his charge has been done by departmental labor, and the results are as good as those obtained by any other city, if not better. His experience is undoubtedly more valuable than that of any other engineer in this country.

One of the editorials suggests that such a society as the American Society of Municipal Improvements should call upon the American Society for Testing Materials to organize suitable committees for the preparation of specifications. When it is remembered that the American Society of Municipal Improvements has among its members, as has been stated before, engineers who have been making specifications for work and supervising its construction for twenty-five or thirty years, it would seem as if they were capable of formulating standard specifications, although no one has more respect or regard for the excellent work that has been done by the American Society for Testing Materials than has the committee.

The committee feels that the Engineering Record wishes to be fair in this matter, and asks that the same prominence be given this communication as was given to the editorials referred to.

Geo. W. Tillson,
Consulting Engineer to the President of Borough of Brooklyn.
Morris R. Sherrerd,
Chief Engineer, Board of Street and Water Commissioners, Newark, N. J.
Edwin A. Fisher,
Consulting Engineer to the City of Rochester.

[The following letter, addressed to Mr. Tillson, is the one referred to in the preceding communication.—Editor.]

Sir: As members of the sub-committee on sheet asphalt paving specifications of the American Society of Municipal Improvements with municipal affiliations, the undersigned wish to register with your committee our emphatic protest against the editorial entitled "A Question of Society Ethics," which appeared in the issue of the Engineering Record of Oct. 17.

Briefly stated, this amazing article assails the personnel of this committee and states that it was dominated by its chairman to such an extent that it recommended a specification which unjustly discriminates in favor of certain of the chairman's clients. It further asserts that the report was made by the chairman and one other, that discussion of the report was violently opposed and that it reverses in an important particular, presumably for improper purposes, the specifications adopted by the Association for Standardizing Paving Specifications. The following record of our proceedings and findings will clearly show that all of these statements are untrue:

The charge of unfitness of the chairman and improper domination by him of the committee is both insulting and false as far as he and all the other members are concerned. The committee was made up of men having long experience in asphalt paving work and, without exception, they are all thoroughly posted on the subject which was assigned to them for consideration. The two members present, who were not city officials, are men whose integrity, honesty of purpose and probity is, in our judgment, beyond reproach and we feel keenly that great injustice has been done them by the unwarranted insinuations made. No attempt of any kind was made to dominate us and it would have been impossible to carry any such attempt to a successful conclusion. This committee was composed of: F. P. Smith (chairman), consulting paving engineer, New York City; R. Keith Compton, chairman and consulting engineer, Paving Commission, Baltimore, Md.; George W. Craig, city engineer, Calgary, Canada; Lester Kirschbraun, Chicago Paving Laboratory, Chicago, Ill.; Dr. Felix Kleeberg, chemist, Bureau of Highways, Borough of Manhattan, New York City; Otto H. Klein, Standard Testing Laboratory, Board of Estimate and Apportionment, New York City; George W. Tonson, former city engineer, Toledo, Ohio; C. H. Underwood, Engineering Chemist, Indianapolis, Ind.

The following members were present at Boston and were continuously in session from Monday morning until their report was finished on Wednesday: Messrs. Smith, Compton, Kirschbraun, Kleeberg and Mehr, the latter representing Mr. Klein.

Prior to this meeting in Boston, practically all of the changes finally adopted were discussed at considerable length by correspondence. No changes were suggested or made that in any way limited competition or prejudicially affected or favored the interests of any manufacturer or set of manufacturers. The *unanimous* sentiment of the committee was unqualifiedly and at all times against the introduction or retention of any clause which might be considered as improperly favoring any manufacturer or set of manufacturers. Our report speaks for itself and it is absolutely false to say that it unjustly favors in any way any producer and we defy the editor of the Engineering Record or anyone else to show that it does. Our report did not materially change the specifications of last year so far as the asphalt requirements are concerned, except that it raised the minimum permissible ductility requirement from 20 cm. to 30 cm., and this is easily met by all good paving asphalts now on the market. Slight changes were made in some of the requirements for binder stone and in the wording of other parts of the specifications. Much of the time of the committee was devoted to a description of the methods recommended for making the various tests called for by the specifications, the limits of accuracy of the methods and the significance of the results obtained by them, as we felt that this would be valuable information especially for many of the smaller cities. *In view of the foregoing and the fact that the asphalt requirements in the American Society of Municipal Improvements specifications are practically identical with those of the S. P. S., we think it pertinent to inquire what interest has been injured by our report and how. If no injury or unjust discrimination has been committed, what is the reason for this editorial, and if an injury or discrimination does exist, what is it and whom does it affect?*

We invite honest criticism. We should be glad to learn wherein these specifications could be improved. We would be among the first to insist that these specifications be revised if an injustice has been done and we think it unfortunate that the Engineering Record "does not propose to go into the merits or demerits of any report presented at the Boston meeting."

So far as any opposition to the proper discussion and consideration of this report is concerned, none was made by any member of this committee or of the society. A motion which was made *before the committee presented its report,* to defer discussion and adoption of it for a year and to adopt without discussion the specifications of another society was opposed, and in our judgment quite rightly. As you know, our report was first presented to your committee and gone over in detail by them and approved before it was presented to the society. It was presented to the society in probably greater detail than that of any other committee. Each change was described in full and the reason for it given, and it was also explained whether these changes accorded or otherwise with the S. P. S. specifications. All of the changes proposed were accepted by the society without a single objection to them and ample time for discussion of them was available and allowed.

The difference between the specifications of the Association for Standardizing Paving Specifications and those of the A. S. M. I., to which the article alludes, consists in the fact that in the former specifications asphalts admitted under them are separated into different classes, whereas this is not done in the A. S. M. I. specifications of 1911, 1912, 1913 and 1914, and in this respect we left them unchanged. This point was carefully considered by our committee and we decided that the A. S. M. I. specifications had stood the test of time, were more concise and that no good purpose would be served by following the S. P. S. specifications in this particular respect.

Regardless of classification, both sets of specifications require that asphalts in order to be acceptable shall pass certain tests. In the S. P. S. specifications certain classes of asphalts are called upon to pass tests which are not required of asphalts coming under other classes. In the A. S. M. I. specifications these tests are applied to all asphalts regardless of class, as it was decided that all the tests were proper and necessary in every instance and because they could be readily met by all refiners. These tests are substantially identical with those contained in the S. P. S. specifications.

R. Keith Compton,
Chairman and Consulting Engineer, Paving Commission, Baltimore, Md.
Felix Kleeberg,
Chemist, Bureau of Highways, Borough of Manhattan, New York City.

[Comment on these letters will be found in the editorial pages of this issue.—Editor.]

Good Roads Prevent Disease, according to the State Board of Health of Kansas. The removal of weeds and trash, which prevent the evaporation of moisture and promote the retention of ground water, deprives mosquitoes, flies and other disease carriers of their breeding spots. Good roads also prevent disease by providing good drainage.